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IN THE REGION OF THE NEW FOSSIL, DÆMONELIX.

BY FREDERICK C. KENYON.

As important as they have been to the paleontologist in yielding perfect remains of the strange looking mammals of Miocene times, the Bad-lands of Nebraska and South Dakota with the neighboring region have received very little attention outside of some of the early government surveys. From the common geological text books one learns that they are in the bed of a Miocene lake, which like several others of the same times on the other side of the Rocky Mountains, received the bones of the animals living on the surrounding shores and buried them under a great mass of sediment. Nearly all of what little has been written has been taken from the writings of Hayden and the notes of Dr. Evans, neither of whom possessed a camera to enable them to give their readers an adequate pictorial idea of the wonderful region that they describe in a few glowing words.

During the summer of 1893 it was my good fortune to spend several weeks in this region in a party that, in consequence of the generosity of the president of the board of regents of the University of Nebraska, had become known as the "Morrill Geological Expedition." Our main object was to study and collect the strange new fossil made known to science during

the previous spring by Professor E. H. Barbour as Dæmonelix, but known for some time to the cowboys and ranchmen of the region where it occurs as "the devil's corkscrew" and "fossil worm."

About noon of the day following our departure from Lincoln we found ourselves in the little town of Harrison, near which Professor Barbour had obtained the one specimen that he had brought back to the University the year before. This is the county seat of Sioux County, which forms the northwestern corner of Nebraska. It is not different from the many small towns that one finds on the prairies of the far west. We found a brick court house, a church, a school-house, a hotel, the almost invariable liquor saloon, several stores, and some two dozen or more dwellings. During Harrison's administration the town had received its name and had had its western boom as the chief and only commercial center of some 300 square miles of territory, constituting Sioux County and supporting, according to the last census, less than 2500 inhabitants. During the summer of 1890 Sioux County, in common with a large number of other Nebraska counties, suffered terribly from drouth. Many of the settlers were compelled to abandon their newly made homes to save themselves from ruin. Among those left behind unable to get away, there was intense suffering. During the succeeding winter many private donations of coal and provisions were sent them by the more favored farmers of the eastern counties. In this work of charity even the State was called upon to lend a hand. But this year the few inches of rain that had fallen had put an entirely different aspect upon everything. Many of the deserted homes that might have been seen in the western counties during the spring of 1891 were now reoccupied and everything looked hopeful. About Harrison the landscape was enlivened by innumerable bright colored flowers. Chief among these were many species of *Astragalus* and related genera of leguminous plants. Here and there could be seen the bright colored spikes of the "loco-weed," rendered famous on western prairies by the baneful effect it has upon every horse unlucky enough to eat it. The animals are not killed, but are made so crazy

that they become unmanageable. Throughout the spring and early summer months there is a wonderful profusion of flowers. As fast as one species finishes its blooming period another takes its place; in fact, whatever one sees is but an earnest of what might be, were rain less uncertain, or could the land be irrigated. But for irrigation, since the greater part of the county is so high above the three small streams that drain it, dependence must be placed upon artesian wells, which would cost more than the average ranchman can afford to pay. The consequence is that one seldom meets with a settler anywhere in the county except in the cañons, where water may be obtained with little trouble.

In early times there may have been over a broad strip of country, west of the Missouri River, a dearth of vegetation that made the name of Great American Desert much more appropriate than at present. It is not unlikely, in fact, it is very probable, that Fremont, when he gave origin to the term, was deceived by the aspect produced by the low creeping buffalo grass. In the eastern part of Nebraska the buffalo grass had almost entirely given place to the blue-stem grasses when the state was admitted into the Union. There has been a constant westward movement of vegetation, though it is doubtful whether, outside of man's influence, it has been as rapid as some of the early writers would have us believe. Still, there is an impression constantly met with among the older settlers that there has been a great change in both climate and vegetation. The territory north of the Platte River, known as the "Sand-hills," is said to have been once entirely bare, but it is now covered with grasses. The yearly amount of moisture precipitated is believed to be, on the whole, steadily increasing. In the extreme western part of the state, in early territorial times, one might sleep in the open air without one's blankets being dampened by a single drop of dew. Now heavy dews fall all over the state.

This constant change of climate is commonly accounted for by the western settler by the breaking up of the prairie sod and the cultivation of the soil, which certainly has enabled much of the rain that has fallen to be retained instead of run-

ning off through the creeks to the Missouri River. Occasionally one meets with a very ludicrous explanation; and not the least among the ludicrous is the idea of electrical disturbances produced by iron rails and barbed wire fences. When there were few fences, and the Union Pacific was about the only railroad in the state, the disturbances were said to be produced by the rails, later the barbed wire fences played the chief part in precipitating atmospheric moisture. In reply to such ignorance and credulity, which, by the way, makes it possible for the early lightning rod swindler or his kind to turn rain maker, about all that need be said is that judging from reports from the various prairie states during the present summer, a great many fences must have been taken down.

Near Harrison and southward the surface of the country rises and falls in long, sometimes "rolling hills." From an altitude of 4871 feet at Harrison it rises to considerably over 5000 on the highest point of Pine Ridge northwest of the town and on the western edge of the state. Through this high table land deep cañons have been worn by the White and Niobrara Rivers on the south, while on the north, the deep, broad valley of Hat Creek has been cut out by an insignificant tributary of the south fork of the Cheyenne. Along the northern edge of this table land and along the edges of that forming the divide further eastward between the White and Niobrara Rivers, may be seen numerous clumps of the western or yellow pine which have given the name to the ridge. Back into the ridge have cut numerous deep cañons the branches of Hat Creek. In these, cottonwoods, box elders, ash, elms, willows, and other trees find enough moisture and protection to flourish. In their upper courses they sometimes break up into numerous deep and precipitous ravines, and at the extreme heads of these are found those eroded places that present the appearance of, and are known as "blow outs." In some cases their lack of connection with the ravines leaves no room for doubt that they can be anything else than wind-formed excavations.

It is in these "blow outs" and ravines that the peculiar "cork-screw" fossil is found. In some cases they may be seen

so thickly strewed about as to give the idea of their having formed a veritable forest. Very few other fossils are found with them. The celebrated fossiliferous or Bad-land formation, is far below.

The more perfect of these corkscrew-like fossils consist of an invariably perpendicular spiral, and, running away and upward from its base, a great, log-like stem. The greatest number of whorls that we found in a single specimen was thirteen, which rose to a height of more than eight feet. The stem of this specimen was some thirteen feet long. Sometimes "screws" may be found without a stem, sometimes the spiral, turning either to the right or left, may be broad and open, at others it may be very close. Now and then a specimen may be found in which there is a central pole-like portion around which the spiral turns. More frequently there is found only a few whorls and a short stem.

At a little lower level than that at which we found the finest specimens, very irregular and prostrate forms are common. In the banks of the ravines they look like so many large tree roots exposed by erosion. In one instance a screw with about three whorls was found at this lower level, which, unlike any other that we had seen, ended below in two roots that branched off from one another at a broad angle.

These strange fossils consist of a white substance a little harder than the semi-petrified calcareous sandstone in which they occur, and, when exposed by wind or water, stand out in bold relief against the cliffs or walls of the ravines and "blow outs." In some cases they project like tree stumps, and, strewn about among these, fragments from a few inches to several feet in length are common. The surface of both spiral and stem may vary from fairly smooth to rough and knotty. Often small filaments are broken off in digging, but as sheet-like layers of similar hardness and appearance are frequently broken through, it may be doubtful whether they really belong to the fossil. Sometimes the knots, or even the whole surface, made up of innumerably fine filaments, may look like that of a hard and compact sponge. In the broken cross section an external whitish ring is presented, surrounding a

great core of a color similar to that of the surrounding rock. This is not quite as hard as the external white ring and often shows sections of large white tubular structures.

What this so-called "corkscrew" may be may remain in mystery for some time to come. The sponge-like appearance of some of the specimens seemed to proclaim it a gigantic fresh water sponge. But microscopic examination brought forth no evidence of the spicules that one would expect. All that could be found of an organic nature was in one or two instances a few plant cells. The presence of these, however, might be explained as living cells of rootlets that had worked into the fossil and in no way belonged to it. In one instance a nearly entire skeleton was found in a stem near its junction with its spiral and suggested the idea that our fossil might be nothing more than the core of a rodent hole. Still another supposition was that it is only a concretionary formation. The peculiar and regular form, lack of concretionary structure, and widespread occurrence at once throws aside the last supposition. The regularity of the spiral, the "pole"-like structure in some of the spirals, the fact that the spiral tapers from top to base, and sometimes may have tapering root-like ends, and finally the presence of tubular structures within the spiral and stem, demonstrate the untenability of the "burrow" idea. If the "cork screw" was the underground stem and root of some aquatic plant it becomes very difficult to explain the presence of the skeleton. If it is supposed to be of a sponge-like nature and growing above the lake bed, the presence of the skeleton may readily be accounted for. It might become entangled in the growing sponge mass and surrounded, just as any pebble or shell may be found to be covered by some existing sponges.[1]

The uniformity with which the "stem" occurs points to a mode of growth that finds its analogy among some of the

[1] Since this paper was written, I have seen a paper by Prof. Barbour giving the last results of his studies. Sections have been made from all parts of the fossil and from numerous specimens with the uniform result of demonstrating the presence of plant cells. These have an average size of 35 to 50 by 16 microns and an evidently parenchemyous nature. Since no others are found, the structure must have been very low in the scale of life.

See University Studies, University of Nebraska, July, 1894.

lower plants and the grasses. This would suppose that a stem starts out from the side, or perhaps the top of a screw and descending downward after awhile sends up a new screw. Then if the connection with the parent screw should be lost through decay, or if the parent screw itself should decay, each "screw" would be left independent. The fact that the distal end of the stem is invariably very rotten lends some weight to this supposition. As yet, no two specimens have been found with any other connection than that produced by crowding.

After three weeks of corkscrew digging in the vicinity of Harrison, we decided to make a short trip southward to the Niobrara, where, we were informed, screws of enormous size, some with tree-like tops, might be found. With the two teams that we had managed to hire in the town, we followed the trail over the prairie to the southeast. Once or twice we passed a lonely "claim," but when these and Harrison had become hidden by the hills behind us, we could look for miles around without seeing a sign of human life. From time to time a jack rabbit would be started and be seen bounding away from our path. The only sounds that we heard, not made by ourselves, were the songs of the black finch (*Calamospiza bicolor*) which was, in fact, very musical. Late in the afternoon we sighted the high hills south of the Niobrara Valley, and towards evening came upon what appeared to be the head of a cañon running down into it. On the lower banks of this a great number of concretions of varying shapes and sizes were strewn about. In general they were oval, and from an inch to several inches through. With the aid of a sledge a number of these were broken off and packed in the wagons. On breaking them they were found to be made up of a great number of thin lamellæ of sandstone, which were alternately dark and light. They lay on the ground as they had been exposed by the erosion of the banks, and were attached to the rock and to one another by small necks.

While busy cracking concretions we were surprised by the ominous aspect of a cloud that had seemed a little while before to be going by, but now was fast coming straight over us. We had barely spread the canvas wagon-covers over the

bows before great drops of rain began to pelt us. In a moment the rain fairly poured down, and we were alternately blinded and deafened by the sharp crackling lightning and the heavy claps of thunder.

If our ribby horses had needed a whip before, they now set off most willingly before the storm. Soon we found ourselves at the edge of the bluff bordering the Niobrara Valley on the north. The valley presented a fine spectacle in the storm. It is not wide, not more than a mile. On the opposite side we could see the steep high bordering hills, and near them the small stream winding through the nearly level valley. By its side the log house of James Cook and his spacious red barns appeared through the misty veil. This was the Agate Springs ranch, whither we had been requested to come to see the giant corkscrews with tree-like tops. Down the declivity before us we went with tightened brakes, which were now and then rendered nearly useless by the slipperiness of the road. We finally reached the level below without mishap, and a little later pulled up before the friendly shelter of the red barns. Shortly after our arrival the rain ceased and we found ourselves in the presence of Mrs. Cook.

Mr. Cook was absent, but during that evening and that of the day following we were most agreeably entertained by Mrs. Cook and Mr. Cook, her brother-in-law. There could have been no greater surprise for us than this finding of so much eastern comfort and refinement so far away from the railroad and civilization. During our entire stay we were most hospitably entertained.

The valley afforded very different scenery from what we had met with farther north. On the south high steep hills rose up from the valley, on the north were high bluffs. Back through these northern bluffs numerous narrow cañons had been cut in times long passed. In none of them was there found a spring or a drop of water. The floor was level and covered with grass. The walls often rose up by a series of great steps which were not infrequently covered with vegetation so that they presented a line of green against the light colored perpendicular walls. On top of some of the bluffs

were outcrops of a thin stratum of siliceous limestone similar to what had been found on some of the hills north of Harrison. Here, however, the siliceous matter was in the form of moss agate and made up by far the larger part of the rock.

In the upper courses of these cañons we found the "corkscrews." We certainly had not been deceived as to their size; the largest that we had seen in the neighborhood of Harrison were pigmies beside some that now presented themselves to view. Few of them were small. Stems and spirals nearly three feet in diameter were not uncommon, but they were not quite so regular and smooth as the smaller ones to which we had become accustomed during our three weeks digging. Many of them were found in which the great spiral seemed to end in a broad top, but in no instance did we see any evidence of the tree-like tops that we had been told were to be found here. The one specimen that was pointed out to us, illustrating this feature, proved to be nothing more than an irregular mass of nodules that had been exposed by the wind and rain in the bank above a "corkscrew." Between the nodules and "corkscrew" there was no connection whatever. These irregular structures of a more or less calcareous nature are very common in the formation in which the corkscrews occur, and may no doubt be found throughout the whole Niobrara formation. They seem to be mentioned by Hayden and others, and it seems strange that the same observers never saw the "corkscrew."

At Agate Springs there were no wash-outs on the south side of the river so as to enable one to say definitely whether the "corkscrew" area extends south of the river. But without doubt they may be found there. During the past year specimens have been found in Dakota, thus extending greatly the large area in which we found them in 1892.

As in the beds near Harrison, fragments were common. One, which came near being left in the field, was turned over and disclosed to view, imbedded in its mass, the legs and several vertebræ of an animal about the size of a large deer. The bones were clamped into the side of the stem just as a

shell might be by a low-growing sponge. This seemed to give additional evidence for the "sponge" idea.

The only other bones that were found on the north side of the river was an Oreodon skull. This was dug out a few inches above the upper end of a "screw." On the hills of the other side of the river, however, fragments of Rhinoceros were not uncommon.

Nearly all the specimens were so large that we were obliged to content ourselves with a few of such small ones as could be readily dug out. These we carefully packed in hay in the wagons, and after a stay at Agate Springs of only a few days, set about our return for Harrison.

After spending a day in packing up, depositing our precious corkscrews in the store room of the depot where they made a goodly pile of boxes, we left Harrison for the Bad-lands and, eventually, the Black Hills. From the Hills, at the head of Sowbelly Cañon, we caught a glimpse of the great Hat Creek Valley to the northeastward. But the view from here is not nearly as striking as that obtained from the buttes further west and north. One can ride up to the edge of these until the broad expanse of the valley, from seven hundred to a thousand feet below, bursts upon him without warning. These views cannot fail to call forth an exclamation of wonder and admiration. At one's feet it seems as though the valley has been formed by a great fault; eastward and northeast it stretches as far as the eye can reach, on the west it rises into the hills of Wyoming, while on the north it seems bounded by the low-lying dark colored hills, the Black Hills, some seventy miles away. If the atmosphere is favorable, Harney's Peak, the highest point of the dark colored range, may be seen. Through the apparently smooth and floor-like valley meanders Hat Creek, gathering up the waters of its various tributaries as it flows along. Scattered along these tributaries, which run back into the ridge from which the view is taken, may be seen small clumps of cottonwoods, so far away as to appear like brushwood. Nearer by and along the foot of the ridge, fields of grain wave in the breeze, while here and there may be seen herds of cattle, moving specks that recall the

cowboy and the ranchman that but a few years ago held entire control of the region. Scattered about the valley, some near, some far off, appear light colored patches sparkling in the sunlight. In the midst of some of them conical mounds rise up like lonely beacons. These are the Bad-lands of Sioux County, the *Mauvaises terres* of the French Canadian traders, and the *Ma-koo-tscha* of the Dakotas.

These bare looking spots one finds upon nearer approach to be great "wash-outs" at the head of the numerous branches of the streams flowing into Hat Creek. In some cases they may be five or six square miles in extent or more, and offer some of the finest erosion scenery, perhaps, to be found anywhere. The whole extent of country covered by them is cut up into numerous and intricately branching precipitous ravines. The tops of the divides between the branches are worn down to knife-like edges, but not infrequently a large plot may be entirely cut off from the upland and present the appearance of a small table-land. It is nearly impossible for a traveller to pass through the labyrinth of ravines with a team; even to one on foot they present innumerable difficulties. They illustrate vividly the method by which nature may level the largest of continents.

From the high ridge bordering the valley on the south a descent can be made only through some of the large cañons cutting back into it. One of these is Sowbelly Cañon, which received its euphonious name from the fact that in the time of Indian troubles a body of troops became surrounded while passing through it, and were kept there so long before assistance came that they had nothing to eat but bacon, or, as it is called by the soldiers, sowbelly. Like the other large cañons it has a small stream of clear and good water, and on its sides is covered by trees and underbrush. The walls rise often perpendicularly, their whitish surfaces glistening in the bright sunlight. In some places they are broken through by branching cañons, and the isolated head-lands form buttes of striking beauty. Sometimes they simulate the works of man. One in particular, near the lower course of the cañon, looks like a gigantic castle in ruins. Here and there great breaches

appeared to have been made in the walls, while below were the great mounds of debris. At one corner appears a great ruined tower, while adding to the effect may be seen scattered patches of green where trees and grasses have caught root, and perhaps an inaccessible eyrie on the side of the cliff. When we saw it there were a pair of bald eagles soaring far above. This structure had been not inappropriately named Castle Butte. Before the advent of the white man they were really used as vantage points of defence as is abundantly attested by the large number of arrow heads that one may pick up at the bases of the cliffs.

This butte formation is characteristic of the White River country. It consists of a fine semi-petrified calcareous sandstone, often containing irregular branching and rootlike concretionary formations such as we found abundantly near Harrison and on the Niobrara. In it also are found the the "corkscrews." Below it is the bed of the Miocene lake consisting of strata of clays, marls, and sandstone, the erosion of which has formed the Bad-lands rendered famous by the paleontological discoveries of Cope, Marsh, and others.

Leaving Sowbelly Cañon behind we drove several miles down into the valley to escape the worst of the ravines near the ridge, and then turned eastward to hunt over a "patch" of Bad-lands where we were certain of finding Menodus remains. About six o'clock, after winding about nearly all day in order to pass the ravines that we could not escape in, in spite of our long detour, we finally reached the railroad near the "patch" of Bad-lands. This we followed to the watering station, Adele. Here we found a depot, a section house, and an artesian well. All through the long hot day's drive after leaving the cañon, we had found no water that did not have considerably more than the chemist's "trace" of alkali. To be sure we carried water, but this could not last long and could not be kept cool. Imagine our disgust when going to the artesian well to quench our thirst to find water so heavily charged with sulphur as to smell perhaps not quite as badly as more or less ancient eggs. We learned that the people at the section house had their water shipped to them from Craw-

ford, about fourteen miles south of Adele. From them we "borrowed" a little water for present use, and learned of a farm house about a mile away, where we might fill our kegs. Hither we went the next day and every day during our stay in the neighborhood and found water not undrinkable, though slightly alkaline. Our horses were compelled to put up with the sulphur water, but strange to say, they did not seem to object. Perhaps they were better acquainted with the vicissitudes of the Bad-lands than we, and were philosophically willing to appreciate what they could get.

Near the depot we made our camp, sleeping on the ground, which, after pulling up a few of the cacti that were very common, did not make an unendurable bed, after a little experience. In the morning we awoke to gaze at the play of the light on the wall of the Bad-lands to the west of us. They present a beautiful appearance, which cannot be appreciated until one gets into them. Then the apparent wall becomes broken into precipitous ravines and narrow cañons with walls rising at so steep an angle as to make climbing very difficult and often impossible. The bare white surface is worn by innumerable gullies, and the inch or so of cracked, sun-baked, and friable clay rattles down the banks beneath one's feet. Not a sign of vegetation can be seen save from time to time in the cañon beds a single plant, an *Astragalus* perhaps, washed down from above and blooming here in loneliness. On some of the "tables" above, among the grasses, may be found a species of *Œnothera* and several of *Phlox*, closely hugging the ground like mountain plants. Beneath the superficial friable layer the clay forms a soft rock that has become cracked and broken into irregular lumps. Now and then a thin seam of gypsum appears, jutting above the surface, while at some of the lower levels calcedony is very common, often affording fine specimens. At one place appeared an outcrop of sandstone which had been worn into fantastically rounded forms. Almost everywhere may be seen the remains of turtles, some on their backs, some right side up, some projecting from the walls of the ravines, others on the level spots, as heaps of fragments. Few of them are small, and some may be found that will ap-

proach three feet in length. Besides the turtles, Oreodon fragments are scattered about. Among the several fine skulls of these animals that we found was one that was entirely perfect and had attached to it some four or five of the cervical vertebræ. On the levels below the three- to four-foot bed of sandstone the scattered remains of that strange looking ungulate, Menodus are frequently met with. Careful search will usually reveal an exposed piece that, when carefully followed with pick and chisels, will prove to be an invaluable specimen. During our short stay in the region a perfect lower jaw of *Menodus* was found. It was lying upside down with only one angle exposed. The rest was buried in the lumps of clay, which, from their hardness and tendency to slip upon one another, made digging very difficult. But by dint of much work with chisels, much paste, glue, many strips of cloth and paper, and much more patience, the jaw was finally freed and turned over. It was a fine specimen, all the teeth were present and perfect, and it was not noticably distorted. In none of the large museums of the east has the author seen a specimen as perfect. The pasted and glued jaw was left in the field that night which, to our anxiety, brought with it a thunder storm. We feared that we should see no more of specimen, or, that it would be totally ruined. Storms severe enough to be cloud-bursts are not unheard of in the region and when they break on the ridge they sweep with terrific force down the gullies and cañons, carrying everything before them to the valley below. Such storms explain the great amount of erosion that has been done, for in none of the cañons, save those that run far back into the ridge and have a growth of trees, can there be found a running stream of water that ever reaches Hat Creek. In some of the larger Bad-land ravines a small stream of water may be found, but such streams are usually swallowed up, leaving a perfectly dry bed before they reach the open plain or have run very far in it. Most of the ravines are completely dry. But the cloud-bursts would carry off the loose, friable, sun-baked earth on the surface of the walls, exposing the indurated clay beneath to be burnt and cracked in its turn.

The following morning we hurried to the scene of our labor and found that the storm had not been very severe. There was the jaw, but horrors, the sound teeth of the day before were all cracked and widely gaping, the glue and paste had been washed off and the whole jaw looked as though the lightest touch would knock it into a mass of useless fragments. But not a piece had fallen. Very carefully we went to work, gently pressed the yawning cracks together, and with rags, glue and melted paraffine, made the specimen as good as new.

After packing the jaw and a number of other specimens they were left at the depot to be shipped later on to Lincoln; then we bade adieu to Adele and its bad-smelling water for the more extensive Bad-lands of South Dakota.

Supposed manner of growth of Dæmonelix.

THE COLD SPRING HARBOR BIOLOGICAL LABORATORY.

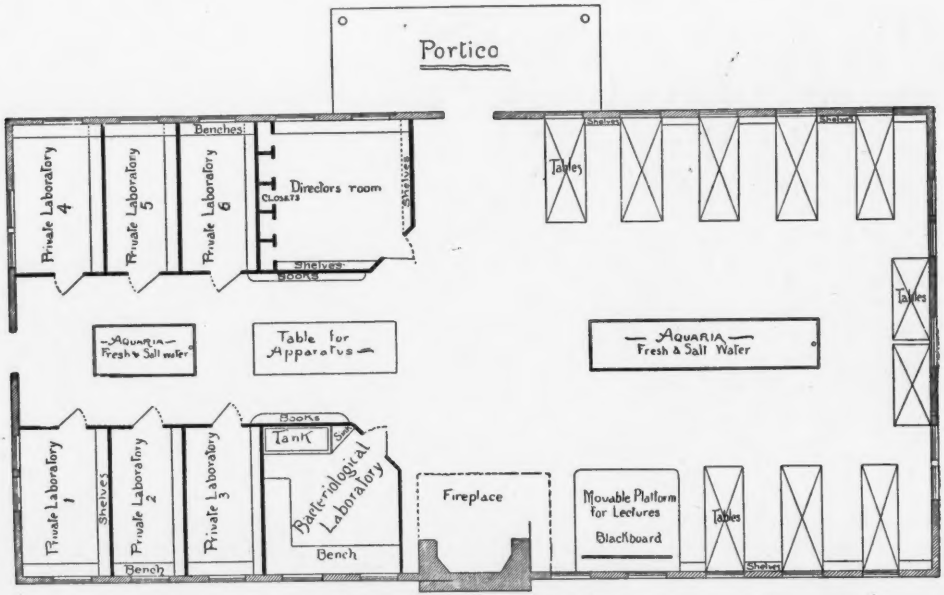
By H. W. Conn.

As elsewhere stated in these pages the American Association for the Advancement of Science at its recent meeting appropriated a sum of money to pay for an investigator's table at the Biological Laboratory at Cold Spring Harbor. This laboratory is little known to most readers of the American Naturalist and a brief account of its history and purposes are, therefore, here given.

The last fifteen years has seen established upon our coast a number of stations designed for the purpose of studying marine biology. The various stations have been quite different in their aims and in their character. Some of them have been purely private institutions where a few students are invited to the sea shore to make use of a private laboratory. In other cases certain universities have established marine laboratories designed primarily for their own students, although receiving students from elsewhere, should they choose to attend. In some cases the laboratories thus organized have been public institutions, and designed from the outset to attract all classes of students interested in biology, and to furnish to students and teachers in general a place where they may come for the purpose of pursuing summer work at the sea shore. Some of them have been planned wholly or almost wholly, for advanced work of investigation, others entirely for elementary work of instruction. Of the various laboratories above designated as public institutions only two have continued to exist for any length of time. One of these, well known to every biologist in the country, is the excellent school, stationed at Woods Holl, Massachusetts. The second one, not so well known, but rapidly coming into notice, is located at Cold Spring Harbor, Long Island.

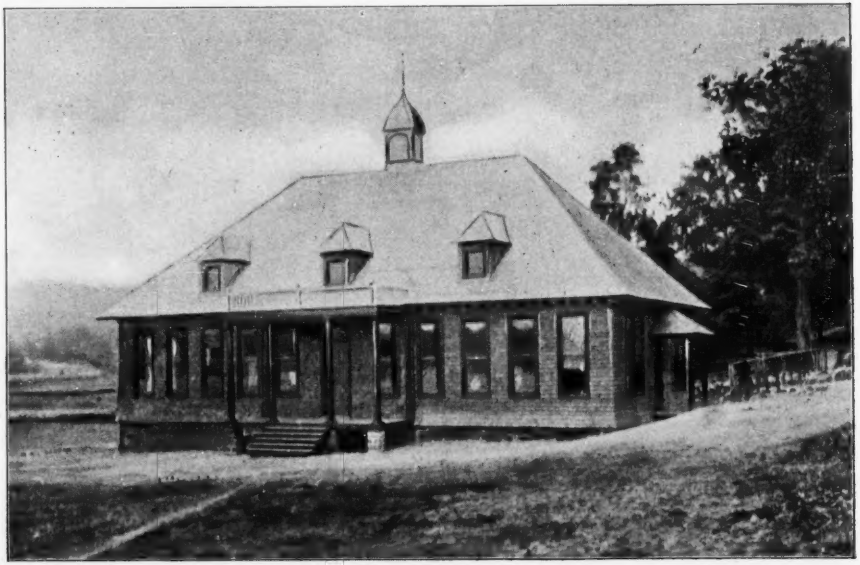
The laboratory at Cold Spring Harbor is, in some respects, especially favorably located. At a distance of an hour's ride

PLATE XII.



Ground plan of the Laboratory.

PLATE XIII.



Laboratory building.

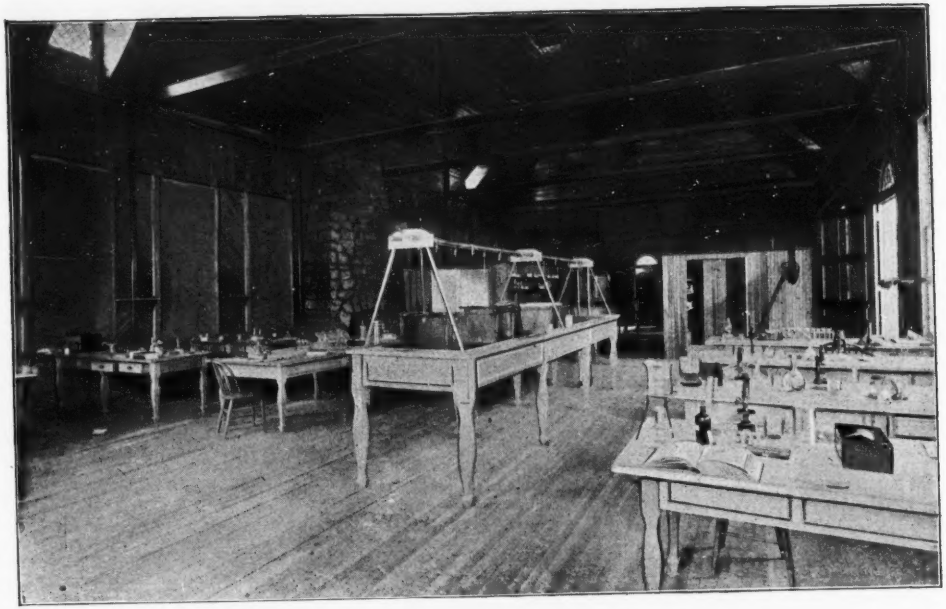
PLATE XIV.

New York Fish Commission Hatchery and out door aquaria.

PLATE XV.

Cold Spring Harbor Bay, showing the Laboratory and Floating dock.

PLATE XVI.



Interior view of Laboratory.

from New York, the great centre of travel, it is most easy of access to students in any of the eastern states. It is situated on the north shore of Long Island at the head of one of its most beautiful bays. A more charming location for a marine laboratory could hardly be chosen. At this place Long Island is somewhat hilly and wooded, in marked contrast to the general flatness which characterizes the greater part of its surface. Here the wooded hills are close to the shore and the forests extend almost to the very water's edge, giving the unusual appearance of a wooded sea shore. The beauty of the place is enhanced by the presence of numerous fresh water springs which have given rise to the name of Cold Spring Harbor, and which pour an undiminished current of the clearest, coldest fresh water into the bay at all seasons of the year, unaffected in amount or in temperature, winter and summer alike. Three beautiful ponds produced by these springs give a fresh water fauna and flora which, added to the marine life of the bay, make the location of the Cold Spring Harbor in some respects unique and especially favorable for biological work.

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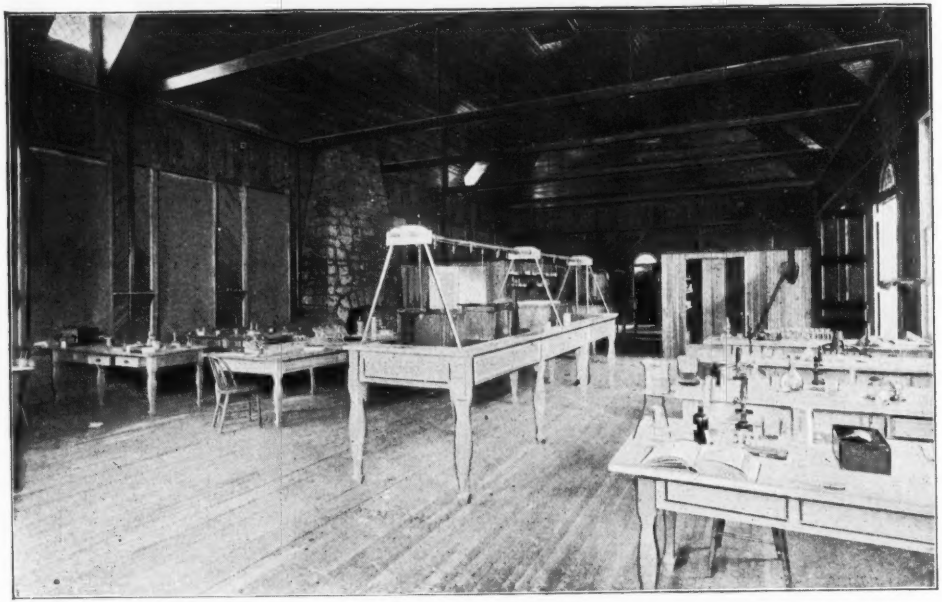
PLATE XV.

Cold Spring Harbor Bay, showing the Laboratory and Floating dock.

PLATE XVI.



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range of territory. At the present time it receives its patronage from a large number of educational institutions and from many of our eastern states. The school has been supported by the Brooklyn Institute aided by the generosity of many friends who have recognized the value of the work. During the first summer the direction of the school was in the hands of Dr. Bashford Bean, now of Columbia College, but during subsequent years of its history and at the present time it is under the direction of Professor H. W. Conn of Wesleyan University. Associated in the work of carrying on instruction have been a number of professors and instructors from our colleges and schools, and each year a competent board of teachers is present to assist the director in carrying on the work of the school.

When the school was organized, it, of course, had no laboratory or equipment. Except for the generosity of the New York Fish Commissioners the school would scarcely have been possible. This board kindly offered to the Institute the use of their hatchery at Cold Spring Harbor, which is very little used during the summer. For three years this building was occupied by the school. Necessary collecting and laboratory apparatus were purchased and with these inadequate conveniences three successful sessions were held. It became evident during the third year that if the school were to succeed it would need a building of its own. The laboratory had by this time made warm friends at Cold Spring Harbor and they generously offered to erect a laboratory building for the purposes of the school. The building was erected in 1893 at an expense of $10,000 and was occupied in completeness for the first time in 1894. The new laboratory is capable of accommodating 50 students, and being especially designed for the school, is admirably adapted to its needs. It contains a general laboratory for general students; private laboratories for investigators; a library; bacteriological laboratory; aquaria furnished with running water, both salt and fresh. In addition, the institution owns boats and collecting apparatus; has a lecture hall and a dark room for photographing, in a separate building; and has the use of a large building devoted to boarding the members of the

laboratory party. During the coming Spring a dormitory building for lodging the students is to be erected, which will add greatly to the conveniences of the students. The equipment of the laboratory in the way of microscopes, small apparatus, chemicals, etc., is excellent, and embraces everything needed to make profitable a summer at the sea shore.

While the object of marine laboratories on our coast has been varied, at the outset most of them were started almost solely for the purpose of encouraging research. In several cases they consisted at first in the collection of a small number of advanced students from special universities who came to the sea shore for the purpose of carrying on work that they could not carry on at home. These little nuclei, in some cases, have grown into large schools and in other cases have remained small collections of investigators. These early students have everywhere taken their places in our institutions of learning and, appreciating their own debt to sea shore work, they are ever encouraging others in the same line of study. As the small laboratory has grown into the school its object has somewhat changed, but in most of the marine schools, that are at present in existence on our coasts, the primal object is that of original research and investigation. In recent years more attention has been given to courses of instruction, but all of the schools, except that at Cold Spring Harbor, aim primarily at encouraging investigation.

The biological laboratory at Cold Spring Harbor was organized, however, with a somewhat different purpose. The Brooklyn Institute itself is a school of public instruction, and the biological school which it organized naturally assumed from the very outset more of the character of a school of instruction than one of research. From the first the aim of the Cold Spring Harbor school has been to furnish a place where instruction in biology of the highest character could be given. For this purpose regular courses of lectures accompanied by courses of laboratory work have been given each year, and, while inviting and encouraging research, its first aim has been instruction. The ordinary student needs guidance the first one or two years at the sea shore. To give him laboratory

facilities without systematic instruction results in much misdirected work. Without systematic courses of instruction many of those desiring the advantages of marine work will spend the summer in desultory work to little profit. To avoid this result the management of the school have planned regular courses of lectures accompanied by laboratory work of the same character as the biological courses in our colleges. The courses which are given at the present time are the following: 1. Elementary Zoology; a course of lectures with laboratory work upon zoological types. 2. Comparative Embryology; this consists of thirty lectures upon embryology, accompanied by practical work with illustrative embryological types. 3. Elementary Botany; including instruction in the study of flowering plants. 4. Cryptogamic Botany; a course of lectures with laboratory work upon the chief types of cryptogams. 5. A course in bacteriology; including 15 lectures upon the history of bacteriology and practical work upon bacteriological methods. All regular courses last six weeks, although the laboratory is open for a longer period. The work done in these courses is of the highest character. Those engaged in instruction are from our best colleges, and the nature of the courses which they give is almost identical with the courses given in the colleges themselves. Indeed, in some respects, the work in these courses at the summer schools is considerably in advance of the work that is done in the colleges in the same departments. The student at the laboratory has several weeks of uninterrupted work upon one subject, and his thoughts are not distracted by numerous other branches of learning which he is pursuing at the same time. This makes it possible for the instruction to be even more thorough and of a higher character than is possible in our colleges. The work in biology done in the school at Cold Spring Harbor is, therefore, of exactly the same character and in some respects more thorough than the biological work in the colleges. Of course not so many branches are taught as may be found in our colleges, but the branches that are taught, which are those especially requiring living specimens at the sea shore for study, are pursued with thoroughness.

The laboratory proposes further to increase its usefulness by furnishing material for class work to our schools. Marine specimens for school purposes have been difficult and expensive to obtain. The Cold Spring Laboratory, therefore, will furnish common types of marine animals at low prices to such schools as need them for work with classes.

For these reasons the school at Cold Spring Harbor offers itself as an especially favorable place for certain classes of students. Students in our colleges who wish to complete the biological work of the inland schools by practical study with animals at the sea shore will find the systematic courses here given of great use to them. Public school teachers who need a practical knowledge of animals and plants to enable them to teach the subjects of zoology and botany in an interesting manner to their students; advanced college students who have taken elementary work and desire a practical knowledge of comparative embryology or advanced zoology; medical students whose regular work in the medical school is so crowded as to leave them little time for general reading; all of these will find the training to be obtained at the summer schools, in general biology, of the utmost value. College professors, too, who desire to make collections for their classes and to obtain material for their own original work will find a place here. All of these classes of students are among the attendants of the school at Cold Spring Harbor and all find much of interest and value in the work at the school.

While, at the beginning, the object of the school at Cold Spring Harbor was to furnish a place of instruction, the more advanced side of biological work has been by no means neglected. The laboratory now in use contains private rooms for investigators. The instructors in the school and the college professors who have been present with the school in past years have been carrying on investigations of original character. Every facility is afforded to those advanced workers who desire to carry on research, and it is the aim of the management of the school to increase rather than to diminish the facilities for investigation, and thus to attract a large number of students engaged in research. During the last summer the

school at Cold Spring Harbor received its first public scientific recognition by the American Association for the Advancement of Science. This Association, on one of the excursions taken by it during its session at Brooklyn the past summer, went to Cold Spring Harbor, and a large party interested in biological work visited the laboratory. The appreciation of the Association for the character of the work done was shown by an appropriation to the school for aiding in original investigations. This money is to be used to pay for the rental of two private rooms to be known as American Association tables, and, as announced elsewhere in this magazine, these tables are open for application to all students of American biology.

The school of Cold Spring Harbor has a field for itself. The growing importance of biological work in our schools is creating yearly an increasing demand for facilities for summer work. The modern teacher is fast learning that he cannot hold his own in zoological or botanical lines without opportunities of practical work with living animals and plants; and these opportunities can be had only at the sea shore itself. There is, therefore, a growing number of teachers who are desirous of spending their summers in adding to their equipment for such work. A growing number of students are recognizing, that, in order to take their stand in the front ranks in our educational communities, a summer or two or more at a marine laboratory is becoming as inevitable a necessity as a college education itself. This growing demand is not to be met by one or two schools, but will necessitate in the future the establishment of many institutions of public instruction. The school at Cold Spring Harbor, by placing emphasis upon this matter of public instruction to teachers and students, has obtained a place for itself. Its continued success and its constant growth during its history prophecies well for its future and promises that it will remain as one of the permanent institutions of public education in America.

MINOR TIME DIVISIONS OF THE ICE AGE.

By Warren Upham.

The following study, forming the conclusion of Part VI in the Twenty-third (1894) Annual Report of the Minnesota Geological Survey, may be regarded as a continuation or supplement of my paper, on the periods of the Quaternary era, given in the American Naturalist last December. It seems to supply a compromise between the doctrine of unity of the Glacial period as held by Dana, Wright, and others, and the alternative doctrine of its duality or greater complexity as held, among American glacialists, by Chamberlin, Salisbury, McGee, and others. Unity or continuity of our Plistocene glaciation, with moderate fluctuations of the ice margin, appears to the present writer the more acceptable view and expression, when the whole period and the whole drift-bearing area are considered. This time was long as measured by centuries or thousands of years, but was in a geologic sense brief as compared with all other geologic periods or epochs, excepting only the shorter, unfinished Recent or Present period.

Seeking to subdivide the Ice age with reference to its dynamic causes and secular fluctuations in climatic conditions, we find, first, a long epoch of general snow and ice accumulation. In its early part the growth of the ice-sheet was interrupted, at least locally and temporarily, by moderate oscillations of its boundary, as shown by layers of lignite between deposits of till observed by Dr. Robert Bell on branches of the Moose and Albany rivers tributary to the southwest side of James bay.[1] Later, after the ice-sheet attained its maximum stage in the Mississippi basin, reaching south to northeastern Kansas, central Missouri and southern Illinois, this epoch included a long interval of extensive retreat of that part of the ice-sheet, followed by renewal of its growth until it again reached far

[1] Geol. Survey of Canada, Report of Progress for 1877–78, p. 4 C; and Annual Report, new series, vol. ii, 1886, p. 38 G.

south toward its former limits. This part of the Ice age is well denominated, from its envelopment of the land by ice-sheets, the Glacial epoch. Its chief cause I think to have been uplifts of the glaciated regions thousands of feet above their present height.

Forest beds and other fossiliferous deposits of the interglacial stage in this epoch are found frequently, and on some large tracts almost continuously, occurring between deposits of the till or glacial drift penetrated by wells, from southeastern Ohio, through Indiana and Illinois, to northeastern Iowa and to Mower county in southern Minnesota.[2] Less frequent, but still sometimes occupying considerable tracts as shown by several wells near together, these interglacial beds are recorded by my notes of wells in Lyon, Renville, and McLeod counties, Minn., 60 to 90 miles north from the south line of this state. More rare instances of their observation are noted as far north as in Mitchell township, Wilkin county, and Barnesville in the south edge of Clay county, Minn.; and these most northern localities are situated within the area of the glacial lake Agassiz, respectively about 100 feet and 75 feet below its highest and earliest or Herman beach. If the altitude and slopes of the land had been then the same as now, an interglacial lake, held by the barrier of the receding ice-sheet, must have forbidden the growth of forests or formation of swamp deposits there, until the outlet was deeply eroded or much farther glacial recession permitted that lake to be drained away northward. Under those conditions an interglacial forest at Barnesville would imply probably three to six times more glacial melting and recession than otherwise would suffice to account

[2] Charles Whittlesey, Smithsonian Contributions, No. 197, in vol. xv, 1864, pp. 13-15.

J. S. Newberry, Geology of Ohio, vol. ii, 1874, pp. 30–33.

G. F. Wright, The Ice Age in North America, 1889, pp. 475–496.

Frank Leverett, Proc. Boston Soc. Nat. Hist., vol. xxiv, pp. 455–459, Jan. 1, 1890; Journal of Geology, vol. i, pp. 129–146, with map, Feb.–March, 1893.

W J McGee, Eleventh An. Rep., U. S. Geol. Survey, for 1889–'90, Part I, pp. 486–496.

N. H. Winchell, Proc. A. A. A. S., vol. xxiv, for 1875, Part II. pp. 43–56; Geology of Minnesota, Final Report, vol. i, 1884, pp. 313, 363, 390.

for the most northern of these observed interglacial deposits. It therefore seems to me more likely that during this glacial retreat the present basin of the Red river of the North, which was later occupied by lake Agassiz, had a considerably greater altitude than now, retaining a part, probably a large part, of its preglacial elevation, and that it was thus a land surface with southward descent and free drainage along the Minnesota river valley to the Mississippi. The recession of the ice-sheet, before its renewed growth, may then have reached only to the southern part of the Red river valley, instead of the great farther distance to Hudson bay, which I formerly supposed in writing of these interglacial beds in Minnesota.[3]

The erosion of numerous and large interglacial stream courses in the early drift sheet of southern Minnesota and northern Iowa, including the Minnesota river valley and its continuation past Brown's Valley and above the bed of lake Traverse, channeled then apparently about 50 feet (or more) below the general surface of the adjoining country to the level of the Herman beach of lake Agassiz,[4] finds full explanation in this retreat of the ice-sheet to the vicinity of Mitchell and Barnesville, 200 to 250 miles inward from its farthest limits in North Dakota and on the northern boundaries of the Wisconsin driftless area, but 500 miles north from its limits in Kansas and Missouri.

During the ensuing stage of its renewed accumulation and growth, the ice-sheet reached from Barnesville about 200 miles westward into North Dakota, an equal distance eastward into northwestern Wisconsin and southeastern Minnesota, and some 350 miles or more south-southeastward in Iowa. Not only were the interglacial forest beds thus covered, but a marginal moraine, which had been formed probably during a slight pause or readvance interrupting the later part of the intermediate glacial retreat, was likewise buried and is now indicated by exceptionally abundant boulders in a stratum of the drift

[3] Geology of Minn., Final Report, vol. i, 1884, pp. 402, 406, 466, 479–485, 507, 511, 552, 580, 581, 585–6, 609, 625; vol. ii, 1888, pp. 138, 186, 187, 199, 456, 529, 555, 662, 668.

[4] Proc. A. A. A. S., vol. xxxii, for 1883, pp. 222–227. Geology of Minn., vol. i, pp. 479–485, 507, 580; vol. ii, 134, 172, 216, 519–525.

shown in the bluffs of the upper part of the Minnesota river valley and by its tributaries, overspread by 25 to 50 feet of the later deposits of till.[5]

The two stages of growth of the ice-sheet may have been due, aside from their principal dependence on the high elevation of the land, to the climatic effects of the last two passages in the precession of the equinoxes, with accompanying nutation, bringing the winters of the northern hemisphere in aphelion about 30,000 years ago and again about 10,000 years ago. The intermediate time of the earth's northern winters in perihelion would be the stage of great retreat of the ice margin in the upper Mississippi region; but eastward, from Ohio to the Atlantic coast, there appears to have been little glacial oscillation.[6] This explanation accords with Prof. N. H. Winchell's computations from the rate of recession of the falls of St. Anthony for the Postglacial or Recent period,[7] and with his estimate of the duration of the interglacial stage from the now buried channel which appears to have been then eroded by the Mississippi river a few miles west of the present gorge below these falls.[8]

The chief cause of the Ice age is here thought to have been a high epeirogenic uplift; but the very noteworthy subdivision of the Glacial epoch in the upper Mississippi basin is ascribed to climatic conditions resulting from the same astronomic cycle of 21,000 years which Croll supposed to have been efficient, during the remote time of maximum eccentricity of the earth's orbit, to produce alternating glacial and interglacial epochs. Wallace, in his discussion of this subject in "Island Life," thinks that great altitude of the glaciated countries coincided with the last stage of maximum eccentricity, from 240,000 to 80,000 years ago, to cause the Ice age,

[5] Geology of Minn., vol. i, p. 626.

[6] J. D. Dana, Am. Jour. Sci., III, vol. xlvi, pp. 327–330, Nov., 1893.

[7] Geol. and Nat. Hist. Survey of Minnesota, Fifth An. Rep., for 1876, pp. 175–189; Final Report, vol. ii, 1888, pp. 313–341, with fifteen plates (views showing recent changes of the falls of St. Anthony, and maps). Quart. Jour. Geol. Soc., London, vol. xxxiv, 1878, pp. 886–901.

[8] Am. Geologist, vol. x, pp. 69–80, with three plates (sections and a map), August, 1892.

altitude and eccentricity being thought perhaps of nearly equal influence. The view here presented looks on the Glacial period as occurring in a much later time of low eccentricity, and for its causation regards altitude as far more efficient than any astronomic conditions. The effects of varying astronomic conditions have been recently considered by Dr George F. Becker,[9] who thinks, altogether differently from Croll, Geikie, and Ball, that the combination of minimum eccentricity of the earth's orbit and maximum obliquity of the ecliptic is most favorable for snow and ice accumulation; and he states that these conditions have existed within the past 40,000 years, until 8,000 years ago, but he apparently would attribute a larger share of the causes of glaciation to geographic conditions, as land elevation. In Europe a very remarkable parallelism of the history of the Ice age with that in America[10] indicates dependence on similar causes, chiefly geographic, as epeirogenic movements, with changes of ocean currents, and subordinately astronomic.

If the Glacial period extended through 30,000 or 50,000 years, depending principally on epeirogenic uplifts and in less degree on the cycles of precession of the equinoxes, it would agree well with Geikie's and Chamberlin's complex history of wavering glaciation, and also with its essential geologic unity and brevity which have been insisted on by Dana, Wright, Hitchcock, Lamplugh, Kendall, Falsan, Holst, Nickitin, and other glacialists. To my mind the diversity and the unity of this period seem like the opposite gold and silver sides of the proverbial shield, concerning which two knights, each having seen only one side, valiantly contended.

Widely extended depression of the ice-burdened land, until mostly it had somewhat less altitude than now, initiated the comparatively short final epoch of the Glacial period. Temperate and warm climatic conditions on the ice border, nearly as now on the same latitudes, then melted away the ice

[9]Am. Jour. Sci., III, vol. xlviii, pp. 95–113, Aug., 1893.

[10]James Geikie, The Great Ice Age, three editions, 1873, 1877, and 1894, notably pp. 774, 775, in the third edition; Journal of Geology, vol. ii, p. 739, Oct.–Nov., 1894; Am. Geologist, vol. xv, p. 54, Jan., 1895.

rapidly; its chief stage of loess deposition attended the early part of this glacial retreat; the partially unburdened land began to rise by a moderate uplift, approximately proportional to the glacial melting and nearly keeping pace with it;[11] and conspicuous belts of morainic drift were amassed whenever the steep waning ice-front slackened its departure, or halted, or for any short time reädvanced. The general but fluctuating retreat of the ice-sheet at length uncovered all the country and constituted the closing or Champlain epoch of the Ice age, so named from the marine beds of that time overlying the till in the basin of lake Champlain and along the St. Lawrence and Ottawa valleys, by which the vertical extent of the subsidence terminating the Glacial period and of the succeeding reëlevation is measured.

Adopting the helpful new nomenclature proposed by Chamberlin,[12] we may provisionally formulate the minor time divisions of the Glacial and Champlain epochs as follows. The order of this table, as of the former more comprehensive one on page 988 of the last December AMERICAN NATURALIST, is stratigraphic, so that for the advancing sequence in time it should be read upward.

NOTE.—If we seek to compare this table with the Glacial series in Europe, it should be remarked that in the Alps there were three chief stages of growth of the glaciers far beyond their present limits, the second being the maximum advance, doubtless contemporaneous, as shown by Geikie, with the maximum extension of the ice-sheet upon northern Europe. The first glacial stage of the Alps, which also appears to have left traces in southern Sweden not wholly obliterated by the next and greater glaciation, may be represented in America by the till beneath the interglacial lignite in the basin of James bay, and these may belong to the time of northern winters in aphelion some 50,000 years ago. The second, third, and fourth glacial stages of the European Ice age, as tabulated by Geikie, are then seen to be wholly analogous in characteristics of ice extension and drift deposition, and they were probably also time equivalents, respectively, with the Kansan, Iowa, and Wisconsin stages in the United States and Canada. In each continent the interglacial time between the Kansan and Iowan stages had

[11] Journal of Geology, vol. ii, pp. 383–395, May–June, 1894.

[12] In two chapters (pages 724–775, with maps forming plates xiv and xv) of J. Geikie's "The Great Ice Age," third edition, 1894, Prof. T. C. Chamberlin proposes a chronologic classification of the North American drift under three formations, named in the order of their age, beginning with the earliest, the Kansan, East Iowan, and East Wisconsin formations.

great subaërial erosion because of the continuing high elevation of the land; and the latest or moraine-forming stage of the glaciation seems, alike in Europe and America, to have belonged to the mainly rapid but fluctuating final retreat of the ice, showing, as I think, that each ice-sheet had in its lower part much englacial drift.

Epochs and Stages of the Glacial period.

CHAMPLAIN EPOCH (Land depression; disappearance of the ice-sheet; partial reëlevation of the land.)	WISCONSIN STAGE ... (Progressing reëlevation.)	Moderate reëlevation of the land, advancing as a permanent wave from south to northeast; continued retreat of the ice along most of its extent, but its maximum advance in southern New England, with fluctuations and the formation of prominent moraines; great glacial lakes on the northern borders of the United States; slight glacial oscillations, with temperate climate nearly as now, at Toronto and Scarboro', Ont.: the sea finally admitted to the St. Lawrence, Champlain, and Ottawa valleys; uplift to the present height completed soon after the departure of the ice. (The great Baltic glacier, and European marginal moraines.)
	CHAMPLAIN SUBSIDENCE	Depression of the ice-covered area from its high Glacial elevation; retreat of the ice from its former Iowan limits; abundant deposition of loess.
GLACIAL EPOCH (Ice accumulation, due to the culmination of the Lafayette epeirogenic uplift.)	IOWAN STAGE	Renewed ice accumulation, covering the forest beds and extending south nearly to its early boundary. (Third European glacial stage.)
	INTERGLACIAL STAGE .	Extensive glacial recession in the upper part of the Mississippi basin; cool temperate climate and coniferous forests up to the waning ice border; much erosion of the early drift.
	KANSAN STAGE	Maximum extent of the ice-sheet in the interior of North America, and also eastward in northern New Jersey. (Maximum glaciation in Europe.)
	UNDETERMINED STAGES of fluctuation in the general growth of the ice-sheet.	Including an early glacial recession and reädvance in the region of the Moose and Albany rivers. (First glacial stage in the Alps.)

THE SKUNK AS A SOURCE OF RABIES.

By W. Wade.

Doubtless many of the readers of the Naturalist have heard the story that the bite of a skunk can convey rabies. I first heard it some years since in the form of an inquiry from a distinguished physician in London; and to an old fox-hunter, who has known of hounds by the dozens being skunk-bitten with no subsequent ill-effects, the story was exceedingly ridiculous. But when my friend stated that Dr. John H. Janeway, a surgeon in the U. S. Army, was said to have given the story his endorsement in a New York medical journal, the matter became immediately worthy of most serious consideration, my friend suggesting that there might have been something in the environments of the skunk, at the time Dr. Janeway wrote, to account for the marvelous exception, and I at once set to work to investigate what was known on the matter. Immediately I was involved in a maze of contradictions, no two stories agreeing. No belief of the story could be found anywhere but in Texas, the Indian Territory, and adjacent districts. Even in southern Kansas no such belief was found. Then in some cases it was the skunk, *Sui generis*, that had this power, while again it was only one particular variety of the skunk, the "hydrophobia cat." The vulgar idea was that any skunk, rabid or non-rabid, was capable of conveying infection of rabies, while more intelligent observers held that only a rabid skunk had this power, but even these seemed to hold that there was special danger of skunks being rabid, or that the virus conveyed by their bite was more potent than that from any other rabid animal. Again, instances were cited of men dying as the result of a skunk bite; in one case after many months of lingering illness, which most certainly could not he rabies, or another case of a man exhibiting rabic symptoms after a skunk bite but recovering on copious bleeding, and evidently there was no rabies *there*. Again, the New

York Sun, about six months since, had a most blood-curdling story of many soldiers in Mississippi dying from the bite of a skunk, and the deaths spread over a period of several months, a marvelously long-lived skunk to live a month after rabies had developed to the stage of being communicable, and inquiries in Mississippi showed that no fatal case of skunk bite was ever known there, although skunks were sometimes kept as vermin killers.

Now remember that this story drew all the weight it could have from the allegation that *Dr. Janeway had endorsed it*, and remember further, that the belief was that the skunk, *at present*, had this power. At last I was able to get Dr. Janeway's paper, which was published in The Medical Record of New York, March 13, 1875, and a more ridiculous breaking down of a ridiculous myth I never saw.

It appears that Dr. Janeway was stationed at Fort Hays, Kansas, when an epidemic of rabies broke out in the surrounding country, and his paper in the Medical Record was based on his report to the Surgeon-General of the U. S. Army; and in a letter to me he says that after writing this paper to the Medical Record, he endeavored to trace the origin of the epidemic, and if he remembers aright, found by inquiries that it was first noticed in the northern tier of Texas counties, and travelled north by west to the Fort Hays reservation.

So far from Dr. Janeway stating that *any* skunk could convey rabies, he distinctly refuted the assertions of some clergyman to this effect, citing instances of dogs and men being bitten by a skunk without injury (and one case wherein one person died and two escaped unhurt from the bite of the same rabid wolf). Dr. Janeway gives a very qualified adhesion to the belief that the bite of a rabid skunk was fatal in a larger proportion of instances than the bite of other animals, and thus explains it:

"That more cases, proportionally, may result fatally from the bite of this animal than from the bite of rabid dogs and wolves, is probably, if not actually, the case; still there are obvious reasons for it to be so. An animal, nocturnal in its habits, generally timid, but armed with a powerful battery to

resist any injury or affront; one that will not bite in defence until the secretion provided for it by nature is exhausted, loses that secretion by the disease. It is a well authenticated fact that rabid skunks are entirely free from the odor so characteristic of these animals, which could not occur if the secretion were not exhausted; and forgetting its normal timidity, will attack any person or animal it may come in contact with, biting the most exposed parts of the body, the alæ of the nose, the lobe of the ear, the thumb or one of the fingers, and passes on. Here is probably the reason these bites are more fatal than those of other animals—always in a vascular part not protected by clothing—which prevents by wiping away the poisonous saliva, from the fierce attacks of the mad dog or wolf and thus saves the life of the one bitten." This is very intelligible and reasonable.

Then, even those who believe that only the *rabid* skunk conveys rabies by its bite, and that the skunk is more susceptible to rabies than other animals, seem to believe that this is the *present* state of affairs, that skunk bites are *now* peculiarly dangerous. Now Dr. Janeway expressly says that rabies was epidemic in Texas when he made his observations on the disease in skunks and other animals, thus: "Rabies Mephitica, like Rabies Canina, is evidently epidemical, no cases of it having been reported previous to 1870 in this region;" and in his letter to me of December 15th, he says: "The epidemic was short-lived, no cases that I heard of occurring the next year. A great number of skunks must have succumbed to the disease, as they were less plentiful after that season;" and further, a surgeon in the U. S. Army, now stationed at Fort Bliss, writes me: "I have served five years in Texas, four in the Indian Territory, four in Dakota and other places where skunks abound; during this time, I have never known anyone to be bitten by the animal referred to. The bite of a rabid skunk will, of course, produce the disease, and in other instances where serious trouble has followed this occurrence, I am of the opinion that the symptoms are due to septic poisoning. The bite or scratch of almost any animal is more or less poisonous from the bacteria always present on the teeth

and claws. Even *human saliva* is poisonous when injected into certain animals, as has been conclusively proved by our present Surgeon-General."

Now I have never been able to get hold of anybody, in Texas or elsewhere (of course, other than Dr. Janeway), that had ever seen a case of skunk rabies, or who had anything like definite evidence on the matter; "I have heard it," "It is generally believed," etc., has been the utmost limit of statements on this point. Some believe it themselves, but are completely "out of reasons for it." One well-known naturalist puts his views on the question in this form:

"1st. The bite of the skunk often communicates rabies and death.

"2nd. Skunk rabies kills more people than dog or wolf rabies.

"3rd. To be bitten by a skunk is to risk a terrible death.

"4th. Beware of all skunks, for one can never tell when a rabid skunk will come along."

And perhaps this expresses intelligent, but incorrect, belief on the subject as well and accurately as it can be done. Therefore let us examine what the actual evidence on the matter is. Dr. Janeway, like any intelligent physician would do, refutes the self-originating idea of rabies in the skunk (and parenthetically, a physician with all the light of recent knowledge as to rabies, tells me that Dr. Janeway's conclusions are singularly sound and conclusive, when the deficency of exact knowledge on the disease, then the case, is taken into consideration). That idea is such utter nonsense that only the erroneous assertion of Dr. Janeway's endorsement entitled it to a second thought. Then Dr. Janeway positively says in his paper in The Medical Record that rabies was epidemic when he made his observations, and he adds in his letter to me that this epidemic was so transient that in one year it had passed away. (Scientific men have suggested, as the probable explanation of such epidemics wearing themselves out, that the subjects die off faster than they can communicate the disease to fresh victims). A surgeon in what is now the central seat of belief in the "skunk-rabies" delusion has not heard of a

case in the nine years he has been in this district. A physician in Southern Kansas, not remote from Fort Hays, wrote me that he had never heard of the skunk-rabies belief, that skunks were not uncommon as pets in his neighborhood (deprived of their scent powers, I believe). From Southern Colorado to North Dakota, I can find no belief prevailing in this myth. Then it all amounts to this: Dr. Janeway made careful observations twenty years ago, during an epidemic, he says this epidemic lasted only a year. A surgeon in the U. S. Army tells us that the ill effects that *do* sometimes follow skunk bites may readily be accounted for as septic poisoning, just as might result from the bite of a fly or the scratch of a tiger's claws. Therefore, my answers to the points I quote from a well known naturalist are:

1st. The bite of a non-rabid skunk can communicate no *rabies*, and it is beyond question that rabid skunks are exceedingly rare, if found at all. In no part of this country were rabid skunks ever reported save during a short period of epidemic rabies in Texas and Kansas.

2nd. Skunk rabies perhaps killed more people in Texas, etc., during a certain period than canine rabies, but because sleeping in the open air ("camping") was common there and the skunks readily encountered men. I think that statistics would show that dog and wolf rabies has caused twenty times the deaths that skunk rabies has.

3rd. To be bitten by a skunk is to risk contracting septic poisoning, I believe a terrible death, and the bite of a fly is said to have produced the same disease, and I think a butcher cutting himself with his butchering knife is in the same danger, but none of them risk *rabies*.

4th. Well, yes, "beware of all skunks" on "smelling" grounds, but it might as well be said "beware of all dogs, for one can never tell when a rabid dog may come along."

Minimizing dangers that are real is most dangerous and reprehensible, but making spooks of mist is but little less so. Some boy reads or hears that skunk-bite "will make a man go mad," some day he does get a skunk bite, and we can easily imagine the terrors he suffers from, and all from the veriest bosh.

The subject of rabies is now loaded down with quite enough rubbish, such as the absurd notion that if a healthy dog bites a man and subsequently becomes rabid, the man will "go mad" also, and adding another piece of bosh is more than we ought to be afflicted with.

I fear I may just now be venturing beyond my depth, and therefore, I wish the following to be taken entirely as suggestive: Must it not have been under very exceptional circumstances that rabies was first introduced among skunks in Texas? It surely is true that rabies is especially a disease of the canidæ, dogs, wolves and? foxes. Now a rabid dog (and I suppose, a rabid wolf), in the stage of the disease in which communication of infection is possible, is about destitute of intelligence. It runs blindly, wildly, and without purpose. The skunk is both nocturnal and retiring, and would easily and naturally get out of the way of a rabid dog "on the run." In Europe where rabies is more prevalent than in this country, the polecat and other animals, relatives and of similar habits to the skunk, are never known to be rabid. So how in the world did the first rabid skunk become so? Unquestionably there *were* rabid skunks, and almost certainly there was a first one who communicated the disease to its fellows, and does it not seem certain that this first victim became infected under most peculiar and exceptional circumstances, and that these are not likely to be be repeated? And, as a final wind-up, What is all this pother about? There is not a particle of evidence that skunk bites are particularly dangerous, and while nobody need wish for such a bite, if he *does* get it he need not worry himself about any danger of rabies.

THE CLASSIFICATION OF THE LEPIDOPTERA.

By Vernon L. Kellogg.

The new provisional classification of the Lepidoptera by Professor J. H. Comstock,[1] based on characters drawn from the wing-structure, presents as its most radical departure from earlier arrangements, the erection within the order of two suborders. One of these groups, the Jugatæ, is thus defined by Professor Comstock: "This suborder includes those moths in which the two wings of each side are united by a membranous lobe, the jugum, borne at the base of the inner margin of the fore wings, and in which the anal area of the hind wings is reduced while the radial is not. The most available recognition character is the similarity in venation of the two pairs of wings; radius being five-branched in the hind wings as well as in the fore wings." This suborder comprises but two families, the Hepialidæ and the Micropterygidæ, each family containing but one genus, *Hepialus* and *Micropteryx* respectively.

The suborder Frenatæ is characterized as follows: "This suborder includes those moths and butterflies in which the two wings of each side are united by a frenulum, borne at the base of the costal margin of the hind wings, or by a substitute for a frenulum, a large humeral area of the hind wings; and in which radius of the hind wings is reduced to an unbranched condition, while in the more generalized forms the anal area is not reduced. The most available recognition character is the dissimilarity in venation of the two pairs of wings, due to the unbranched condition of radius of the hind wings, while this vein in the fore wings separates into several branches." The Frenatæ includes all the families of Lepidoptera except the Hepialidæ and the Micropterygidæ.

[1] Comstock, John Henry. Evolution and Taxonomy: An Essay on the application of the Theory of Natural Selection in the Classification of Animals and Plants, illustrated by a study of the evolution of the wings of insects and by a contribution to the Classification of the Lepidoptera, pp. 37–113, with 33 figs. and 3 plates, in the Wilder Quarter-Century Book, 1893, Ithaca, N. Y.

Properly to estimate the value of these subordinal characters it may be necessary for systematists to acquaint themselves with the position of Professor Comstock regarding systematic work. His point of view may differ from that of some. The essential feature of it is the insistence upon the constant recognition of the theory of descent in systematic work, no matter how circumscribed the group which is being studied. "The description of a species, genus, family or order will be considered incomplete," says Professor Comstock, "until its phylogeny has been determined so far as is possible with the data at hand."

The purpose of this paper, which is merely to add a few notes of observations which seem to be confirmatory of the most conspicuous feature of this new classification of the Lepidoptera, makes it impracticable to refer at all adequately to the method proposed by Professor Comstock for phylogenetic studies, but it is necessary to call attention here to the following paragraph from the essay referred to.

"In attempting to work out the phylogeny of a group of organisms, there will arise, I believe, the necessity of distinguishing between two kinds of characters: first, characters indicating differences in kind of specialization; and second, characters indicating differences in degree of specialization of the same kind. The former will indicate dichotomous divisions of lines of descent; the latter will merely indicate degrees of divergence from a primitive type. Thus, to draw an illustration from the following pages, it is shown that there are two distinct ways of uniting the two wings of each side in the Lepidoptera; they may be united by a frenulum, or they may be united by a jugum. These are differences in kind of specialization, and indicate two distinct lines of descent or a dichotomous division of the order. Among those Lepidoptera in which the wings are united by a frenulum, great differences occur in the degree to which this organ or a substitute for it is developed; such differences may merely indicate the degree of divergence from a primitive type and may need to be correlated with other characters to indicate dichotomous divisions."

In a study of the scales of the Lepidoptera (the results of which have been elsewhere recorded[2]), a careful examination of the wing-membranes of *Micropteryx* revealed on them, in addition to the numerous specialized scales arranged in regular rows or tiers over the membrane, a covering of very fine hairs, differing radically from the scales in size, arrangement, and mode of attachment to the membrane. These minute hairs are present in all the species of *Micropteryx* I have examined, viz.: *unimaculella, mansuetella, clathrata, anderschella, chrysolepidella, thunbergella, sparmanella, aruncella, fastuosella, seppella, semipurpurella.* And further, are present in all species of *Hepialus* yet examined by me, viz.: *sylvinus, gracilis, humuli, argentata, haydenii, hecta, purpurascens, argenteomaculatus, mcglashani, behrensii* and its variety, *montanus.*

On the other hand, I have yet to discover these minute hairs in any one of the Frenatæ, though I have examined a large number of forms distributed widely over the group. I am convinced that the presence of this clothing of minute hairs on the wing-membranes of the Jugatæ is a subordinal character.

[3]This clothing may be more specifically described as follows: in *Micropteryx unimaculella,* the fore and hind wings on their upper and lower sides are sparsely covered with fine, curving, pointed, short hairs, not inserted in sockets or "insertion cups," as are the scales, and not easily rubbed off. These hairs average .005 millimeters in length, and are distant from each other at their bases a length approximately equal to the length of the hairs. The scales of *unimaculella* average from .1 to .15 millimeters in length.

In *Hepialus sylvinus* the wings are similarly covered with fine hairs, averaging from .02 to .03 millimeters in length. The scales of *sylvinus* are from .2 to .3 millimeters long, or about ten times the length of the fine hairs, which I shall hereafter refer to as the "fine hairs" or the "fixed hairs."

[2] Kellogg, V. L., The Taxonomic Value of the Scales in the Lepidoptera, pp. 45–89, with 17 figs. and plates IX and X, Kansas University Quarterly, Vol. III, No. 1, July, 1894.

[3] This paragraph and two or three succeeding ones referring to wing-clothing are mostly quoted from my paper on the lepidopterous scales before referred to.

Beyond the availability of the presence of the fine hairs in in the Jugatæ and their absence in the Frenatæ, as a recognition character, the phylogenetic significance of this character seems to me of interest, and if I interpret it aright, especially interesting in the light of Professor Comstock's recognition of two main branches of the Lepidoptera. The Jugatæ, according to Professor Comstock, are the more generalized group of the two. The venation indicates this strongly; *Micropteryx* possesses the most generalized mouthparts to be found among Lepidoptera; and, lastly, the mode of tying the wings together is the same as obtains in many of the Trichoptera, a a group of neuropteroid insects offering many indications of affinity with the Lepidoptera. In addition to these indications, or, indeed demonstrations, of the generalized condition of the group Jugatæ, the clothing of the wings is essentially that of the [4]Trichoptera, only in more specialized state. On the wings of the Trichoptera there is a distinct clothing of fixed hairs, unstriated, not set in sockets, and not easily removed. In addition there is a sparse covering of specialized hairs, striated, set in sockets, easily rubbed off, very long and large compared with the much more numerous fixed hairs, and evidently the lepidopterous scale in generalized state.[5]

The wing-clothing of the Jugatæ is more specialized than that of the Trichoptera in two ways: first, by the degradation of the fine hairs, tending toward that total disappearance which is characteristic of the Frenatæ; and second, by a specialization by addition, in the case of the scales, which have, indeed, reached almost as high a degree of development as is to be found among the Heterocera. This high specialization of the scales in *Micropteryx* and *Hepialus* does not at all indicate a high rank for them among Lepidoptera, but merely is confirmative of the presumption that they are the existing tips of branches whose lower members have disappeared. Nor, in-

[4] I have described and compared the clothing of the wings of the Trichoptera and Lepidoptera, in some detail, in the paper on the taxonomic value of the scales of Lepidoptera (*loc. cit.*).

[5] The beginnings of this kind of wing-clothing are perhaps apparent in the Panorpidæ.

deed, is it necessary to believe that these branches have been long ones, for, as I have elsewhere shown[6], the specialization of scales can come about very rapidly.

It seems probable that the stem-form of the Lepidoptera possessed a wing-clothing much like that now exhibited by the Trichoptera, and that the Jugatæ branched off before the covering of fine hairs had been lost, although the tendency of specialization had already become manifest. The phylogenetic position of the Jugatæ, indicated by their wing-clothing, quite corresponds with that indicated by the wing venation as shown by Professor Comstock.

Another characteristic of the Jugatæ, not so distinctly available as a recognition character, but of considerable phylogenetic significance, is presented by the structure of the thorax.

The thoracic structure of the common, wingless, racial form of the Hexapoda is probably pretty fairly shown by the living Campodeas. With the appearance of wings the musculature of the two hinder segments of the thorax was necessarily largely increased, and those segments increased in size and strength. The chitinous exoskeleton became especially firm and strong for the attachment of the muscles, and the two segments acquired a bulk and form proportional to the extra development of the musculature. In the more generalized of winged insects the two pairs of wings are subequal in size and importance, and are quite independent of each other. Correspondingly, the meso- and metathoracic segments are subequal in size and form. The Paleodictyoptera of Scudder, including all the Paleozoic insects, are credited by him with the following characters (among others): "thoracic segments subequally developed; both wings closely similar in shape and with a simple neuration." The condition of wings and thorax in many of the living generalized neuropteroid insects well illustrates this state. (See fig. 1, plate XVII.)

But the parachute-like function which these broad subequal wings subserved began to give way to a more effective aerial locomotion. A tying together of the fore and hind wings of each side to secure synchronous action, and a

[6] See paper on scales referred to.

cephalization of the flight function, manifested by a reduction of the hind wings and a specialization of the fore wings as strongly supported firm plates for rapidly beating the air obtained. This synchronity of action by the two pairs of wings and the cephalization of the flight function, was accompanied by coincident structural changes in the segments containing the wing musculature. With the loss of independence by the two pairs of wings, and the development of their united action, the meso- and metathoraces became more and more combined until in some cases they are so nearly fused as to form a single strong box for the wing musculature. The cephalization of flight or the reduction of the hind wings and the specialization of the fore wings is accompanied by a corresponding reduction in size and importance of the metathorax, and a marked increase in size of the mesothorax.

The musculature of the legs is also, of course, contained in the thoracic segments, but where, as in the Lepidoptera, the functions of the legs are so largely reduced, so overshadowed by the flight function that the anatomy of the thorax depends almost entirely on the specialization of the wings, and where, as is also the case in the Lepidoptera, the flight function and consequent condition of the wings is of so much [7] importance in the economy of the organisms, it is evident that the testimony borne by the thoracic anatomy should be a contribution of real importance towards a comprehension of the phylogeny of the group.

As a fair example of the lepidopterous thorax in a species certainly not among the more highly specialized Lepidoptera, and admittedly not belonging to the most generalized forms, I have taken the thorax of *Actias luna*. As our interest lies in the meso- and metasegments, being the ones directly connected with the function of flight, I may omit reference to the prothorax.

The scutum of the mesothorax in *luna* (See fig. 2, plate XVII) is the largest sclerite of the dorsum, and presents a greater surface than all the rest of the dorsal sclerites of the meso- and metathorax combined. It is longer than broad, is traversed

[7] See Comstock, *loc. cit.*, p. 51.

by a faint longitudinal median carina, and its posterior border presents a reëntrant angle into which the forward-projecting apex of the scutellum fits. The scutellum of the mesothorax is subtriangular in outline with rounding angles. The dorsum of the metathorax is less than one-third as long as the meso-notum. The scutum is chiefly apparent in its two lateral portions, the median portion being reduced to a narrow transverse bar; the scutellum is a small transversal sclerite with a curving anterior margin. The pleural aspect of the mesothorax is markedly greater than that of the metathorax, but the relation between them does not show such a preponderance of the mesothorax as is shown on the dorsum.

With the specialization of the flight function indicated by a cephalization of flight, including a specialization of the fore-wings and a reduction of the hind-wings, there comes a correlative change in thoracic structure. This may be shown in *Hemaris thysbe*, one of the swift-flying sphinges, with a highly specialized venation. The mesonotum (see fig. 3, plate XVII) constitutes almost the entire dorsal aspect of the thorax, the metanotum being limited to a very narrow transverse bar, dilating laterally to more conspicuous dimensions. The scutum of the mesothorax is almost as broad as long.

Turning now to the Jugatæ, the venation of whose wings, according to Professor Comstock, is the most generalized of any among the Lepidoptera, an examination of the thorax reveals a distinctly generalized condition. In *Micropteryx unimaculella* (see fig. 4, plate XVII) the mesonotum does not exceed the metanotum in length by more than one-half the length of the latter. The general outlines of the dorsum of both segments are much alike, and the scutum and scutellum of the mesonotum resemble the equivalent sclerites of the metanotum in shape. In each segment the scutellum projects forward into an angular emargination of the hind border of the scutum. In the more specialized forms of the Lepidoptera the reduction of the metanotum is accompanied by the narrowing of the median portion of the scutum, until, in many cases, the scutum is divided, apparently, by the scutellum into two lateral pieces.

In *Hepialus humuli* (see fig. 5, plate XVII) the mesonotum is relatively larger, compared with the metanotum, than in *Micropteryx*, and there is correspondingly more of a difference of outline between the two segments, but the thorax is still distinctly a generalized one. The metanotum is about one-half as long as the mesonotum.

Nowhere else among Lepidoptera have I found so generalized a condition of the thorax, as shown by the Jugatæ, unless it be in the Tineina, where, indeed, among all Frenatæ, it would be expected. In *Tinea vestitella* the thoracic structure appears to be in a very generalized state, although the shape of the sclerites differs much from that in the Jugatæ.

An additional point of interest is adduced by a comparison of the thorax of the Jugatæ with that of the Trichoptera. A striking resemblance is apparent, as is illustrated in figures 4 and 6, one being the dorsal aspect of the thorax of *Micropteryx unimaculella*, and the other that of *Hydropsyche phalerata*. This suggests again the affinity of the Lepidoptera, through the Jugatæ, with the Trichoptera.

The patagia of the mesothorax exhibit an interesting specialization following closely the development of the flight function as indicated by the wing venation and the thoracic structure. The patagia probably function as shields or protective coverings for the insertions of the front wings, the thin lobe curving around the base of the fore-wing in a way well calculated to protect this unchitinized and vulnerable portion of the moth's body. In the swift-flying sphinges the patagia acquire a remarkable development, extending posteriorly almost to the hinder margin of the mesoscutum. In the more generalized *luna* the patagia are much less developed, and in the Jugatæ the patagia are very small and inconspicuous. The patagia are present also in the Trichoptera, and are strikingly like the equivalent processes on the Jugatæ.

A careful study of the thorax of the Lepidoptera must certainly be rewarded by suggestive results.

As to the kind of characters which these drawn from the wing-clothing and thoracic structure are, I refer to the paragraph at the beginning of this paper quoted from Professor

Comstock's essay, relating to two kinds of characters; first, characters indicating dichotomous divisions of lines of descent; second, characters indicating degrees of divergence from a primitive type. It is evident that either one of these kinds of characters may be subordinate to the other, although, at first glance, perhaps, it might seem that characters indicating differences in kind of specialization, or dichotomous divisions of descent lines, must always be superior to characters indicating differences in degree of the same kind of specialization. For example, given a dichotomous branching according to characters of the first kind, the forms along either line will be ranged according to characters of the second kind, *i. e.*, differences in degree of specialization along that line. But, in a larger view, there is, in the development of any considerable group of organism, as, for example, the class Insecta, a general tendency of specialization along some pretty distinct main line, or more or less nearly parallel lines. For example, in the Insecta may be adduced the development of the flight function accompanied, in the Lepidoptera, by a cephalization of flight indicated by the specialization of the front wings and a reduction of the hind wings and accompanied also by the specialization of the thorax in the manner pointed out in this paper. Subordinate to any general tendency, such as the development of the flight function, there will appear characters indicating dichotomous divisions of lines of descent, the methods of advance along the line of the general tendency differing in two branches of the group. An example of this is afforded by the Odonata and the Diptera; in one group the specialization of fore and hindwings has followed the same lines, in the other the specialization has resulted in the loss of the hindwings. In both instances a fine development of the flight function has been reached.

Of the kind of characters indicating in a general and large way degrees of divergence from a primitive type, these characters drawn from the wing-clothing and thoracic structures may be looked on.

Explanation of Plate, XVII.

Fig. 1.—Meso- and metanotum of *Corydalis cornuta.*
Fig. 2.—Meso- and metanotum of *Actias luna.*
Fig. 3.—Meso- and metanotum of *Hemaris thysbe.*
Fig. 4.—Meso- and metanotum of *Micropteryx unimaculella.*
Fig. 5.—Meso- and metanotum of *Hepialus humuli.*
Fig. 6.—Meso- and metanotum of *Hydropsyche phalerata.*

In all the figures: a = scutum of mesonotum; b = scutellum of mesonotum; c = scutum of metanotum; d = scutellum of metanotum; p = patagia = paratera of mesonotum.

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RECENT LITERATURE.

The Glacial Nightmare and The Flood.[1]—In these two volumes Sir Henry Howorth undertakes to show how the Glacial Theory, as usually taught, is not sound, that it is based upon hypotheses, some of which cannot be verified, while others can be shown to be false. In facing the solution of the Drift problem be postulates a catastrophe, viz., a widespread flood, to explain the geological phenomena of the Plistocene period, and to account for the extinction of the fauna of that time. The work is limited to a consideration of the so-called drift beds and frequent reference to the literature of the subject is made. The opening chapters are compilations of the arguments advanced and conclusions reached by all authorities of the present century upon the subject, and many who date from the middle of the last. The second volume discusses the inadequacy of ice to meet the calls made upon its working power by the glacialists, with a concluding chapter in which the author claims that the only explanation of the distribution of the drift is a great diluvial catastrophe, and he points out in detail how the many facts of the drift are in accord with this theory. Examples are cited of the distribution by rapidly moving water of erratics, and also of the production of striæ by the latter. In some cases these striæ are seen on the blocks transported by the water, and again upon the surfaces over which the detritus has been impelled.

An important omission in the chain of evidence presented by Mr. Howorth, in favor of his theory, is the *cause* of the flood. Save for a brief reference in his preface to "the rapid and perhaps sudden upheaval of some of the largest mountain chains in the world, accompanied probably by great subsidences of land elsewhere," there is no reference to this point, upon which the whole theory seems to rest.

Life Histories of North American Birds.[2]—This work is one of a series in quarto form intended to illustrate the collections in the U. S. National Museum. The present volume relates only to land birds, and while the main object is to make it a systematic and com-

[1] The Glacial Nightmare and The Flood. 2 vols. By Sir Henry H. Howorth. London, 1893. Sampson Low, Marston and Co. Publishers.

[2] Life Histories of Birds, with special reference to their Breeding Habits and Eggs. By Charles Bendire, Captain, U. S. A. Special Bulletin No. 1, U. S. Natl. Mus. Washington, 1892.

prehensive work on the oölogy of North America there is incorporated in the text the latest information as to the life history, the migratory and breeding ranges, and the food of each species. The classification given in the Code and Check List of the American Ornithologists' Union has been followed.

The illustrations comprise 12 chromolithographic plates, reproduced from water-color drawings of eggs belonging to the collections in the U. S. Natl. Museum.

The long residence of Capt. Bendire in the far west, has given him exceptional opportunities for observing the habits of the birds. He describes them in a most interesting manner, and he weaves into his narratives some glimpses of military life, and frontier adventure, which add an especial flavor to the book.

Geology of the Coastal Plain of Alabama.[3]—Under this title Mr. E. A. Smith presents a report which embodies the results of a thorough study of the Cenozoic formations of the Coastal Plain of Alabama. Part I is substantially a republication of Bull. 43 U. S. Geol. Surv. with some additions and slight alterations, followed by a full report by D. W. Langdon of the variations of the Eocene and Cretaceous formations in the territory between the Alabama and Chattahoochee rivers, together with a account of his discoveries of the Marine Miocene formations at Chattahoochee and Alum Bluff in Florida. Part II deals with the various phosphatic marls, green sands, etc., occurring in this part of the state. Part III, includes county descriptions in detail.

The series of Marine Eocene and Cretaceous formations is exposed along the Alabama rivers more fully than anywhere else in the Eastern States, and the scale here illustrated will serve as a standard for other regions.

Thirteenth Annual Report of the U. S. Geological Survey for 1891–'92. Part II.[4]—The report of the Director for 1891–'92 is published in three parts, of which Part II is devoted to Geology and comprises the following papers: Second Expedition to Mt. St. Elias including an account of the Malaspina Glacier, by Israel Cook Russell; The Geological History of Harbors, by N. S. Shaler; The Mechanics

[3] Report on the Geology of the Coastal Plain of Alabama by E. A. Smith, L. C. Johnson and D. W. Langdon, Jr. With Contributions to its Paleontology by T. H. Aldrich and K. M. Cunningham. Montgomery, Alabama, 1894.

[4] Thirteenth Annual Report of the United States Geological Survey, 1891–'92, Pt. II, Geology; Pt. III, Irrigation. By J. W. Powell. Washington, 1893.

of Appalachian Structure, Bailey Willis; The Average Elevation of the United States, by Henry Gannett; The Rensselaer Grit Plateau in New York, by T. Nelson Dale; The American Tertiary Aphidæ, by Samuel Hubbard Scudder.

The same report, Part III, constitutes the fourth in the series of reports of the Irrigation Survey. The water supply for irrigation is discussed by Mr. E. H. Newell, special attention being given to the drainage basins of the Missouri, the Yellowstone and the Platte rivers. The principal features distinguishing American irrigation engineering are described by Mr. H. W. Wilson, together with the engineering results obtained by the Irrigation Survey. Two topographic reports relating to the location and survey of reservior sites are contributed by Mr. A. H. Thompson. The various reports are abundantly illustrated.

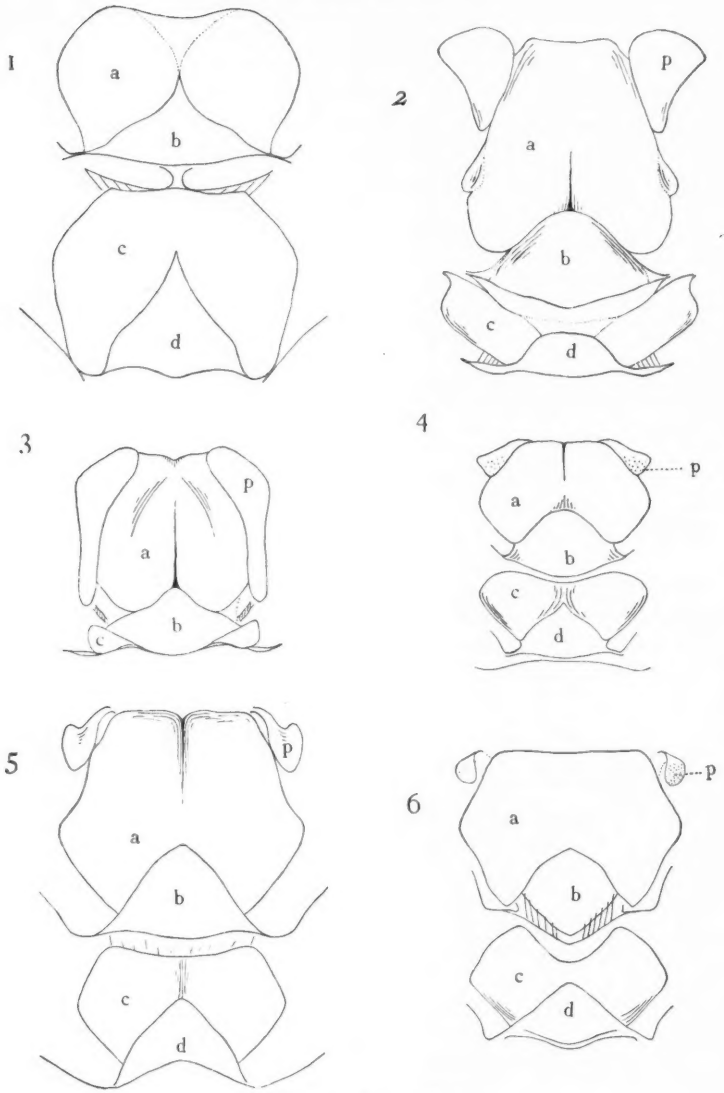
Reports of the Geological Survey of Arkansas for 1891 and 1892.[5]—These two Reports representing Vol. II of the Survey are bound in two separate books. The report for 1891 comprises papers on the work accomplished by the Survey by Branner, Simonds, Hopkins, and Siebenthal. In addition are Miscellaneous Reports on the fauna of the state, magnetic observations and bibliography of the Geology of Arkansas to date.

The report for 1892[6] embraces the work undertaken by the Survey for the purpose of distinguishing the subdivisions of the Cenozoic formation of Arkansas and for determining their areal distribution in the southern part of the state. This work was accomplished by Prof. G. D. Harris. Both Reports are illustrated with a number of well executed plates.

[5] Annual Report of the Geological Survey of Arkansas for 1891. Miscellaneous Reports, 1894.

[6] Annual Report of the Geological Survey of Arkansas for 1892. Tertiary Geology of Southern Arkansas, 1894.

PLATE XVII.



Kellogg on Lepidoptera.

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General Notes.

GEOGRAPHY AND TRAVELS.

African Volcanoes—In 1891, when Emin Pasha started west from Victoria Nyanza on the journey that ended in his violent death, he and his comrade, Dr. Stuhlman, were the first white men to see the big mountain Mfumbiro, 120 miles from the lake which Captain Speke, many years before, had placed on his map on native information. They found that the Mfumbiro was not an isolated cone, but the most eastern of a hitherto unknown range of volcanic origin. Their first purpose was to determine the outlines of Lake Albert Edward, and they did not stop to explore these mountains; but Dr. Stuhlman sent home an interesting report of the natives that Virunga, the most western summit of the chain, was a fire mountain, from whose top smoke was often seen to issue, and from which noises were heard like the bellowing of cattle.

On December 8th a cablegram reached Europe from Count von Gotzen, the German explorer, announcing his arrival on the lower Congo, after crossing Africa from east to west. About the same time a letter he had written in Central Africa, in June last, arrived. It contained brief but interesting detail of his visit to Mount Virunga. There have been reports of plutonic activity among the Rif Mountains in northwestern Morocco, but the hostile natives have prevented investigation. The subterranean forces that formed the great trough and piled up mountains of lava and ashes east of the great lakes show, by solfataras, hot springs and other phenomena, that they are not yet entirely spent. But until the discovery of Mount Virunga, no active volcano was known to exist in Africa.

While still far away Count von Gotzen saw a thin column of smoke ascending from the principal crater, and later he found that the rim of this orifice is 11,400 feet above the sea. The volcano, therefore, is not a snow mountain, and is not so tall as its nearest neighbor on the east, which, according to Stuhlman, is about 13,000 feet high. It took von Gotzen several days to force a passage through the dense forest and to scale the steep mountain side. At last he stood upon the edge of the crater and looked down upon a most interesting spectacle.

The crater is about a mile in diameter, and the top of the encircling wall on which the explorer stood, is about 160 feet above the crater floor. The inner side of the wall was too steep for comfortable descent, and, in view of what was going on at the bottom, there was absolutely no temptation to make the journey.

The yellow-hued bottom of the crater floor was as smooth as the surface of a lake, and the explorer believes he was looking down upon an expanse of molten lava. Above this smooth surface rose the walls of two orifices, which was over 300 feet in diameter; a small volume of smoke was issuing accompanied by a noise that sounded like the roll of distant thunder. There were unmistakable indications that outside of this crater another center of eruption exists on the west side of the mountain, but the explorer was unable to push through the woods to reach it.

For some years a little lake has appeared on the maps some distance south of the place this volcano has been found to occupy. It is Lake Kivu, seen by no white man until von Gotzen stood on its shores soon after he had looked down in the smoking crater. He says the lake stretched away before him like a sea, and, though it was a clear day, he could not see its southern shores. He believes the lake is almost as large as Lake Albert Edward. Its outlet is supposed to be the Rusisi River, which enters the north end of Lake Tanganyika.

It is too early to regard the large prizes of African discovery as all won when such interesting and important results reward research, as those attained by the latest traveler across Africa. (From N. Y. Sun in Scientific American, Jan. 5, 1895).

MINERALOGY.[1]

New Instruments.

Goniometer with two Graduated Circles.—Goldschmidt[2] has devised a new form of goniometer which he has called *Goniometer mit zwei Kreisen.* Besides the horizontal graduated circle there is in this instrument a vertical graduated circle, and it is this circle which is fitted with the usual centering and adjusting support for the crystal. The vertical circle and its attachments are supported by an arm which revolves about the axis of the horizontal circle. The collimator and telescope are constructed as in the goniometer with horizontal circle, and for measurement are so placed that their axes make equal angles with the zero position of the revolving arm and movable axis. The crystal is adjusted for the prism zone and brought into the unmovable axis of the instrument. The pole of any face of a crystal is located in the same manner as a point of the earth's surface by latitude or longitude, or a star by right ascension or declination. To determine a plane *by reflection* the adjusted crystal is revolved about the movable axis (vertical circle) till the face is perpendicular to the plane of the horizontal circle (φ). The movable arm is then revolved about the unmovable axis until the face is normal to the zero position of the arm—makes equal angles with the axes of collimator and telescope (ς)—when the image of the signal will appear on the cross hairs of the telescope. The position of a plane can also be determined by the angles through which it is necessary to turn it to make it appear as a line parallel to one of the cross hairs of the telescope. The inventor claims for the instrument, among other advantages over the forms in use, that measurements are more quickly and conveniently made, and that the calculation of crystallographical constants and symbols and the making of projections are much simpler. It is necessary to mount the crystals but once for the entire measurement, and pyramid planes require but a single adjustment. The position of a face is determined without reference to the perfection of its neighbors. Angle tables can be constructed corresponding to a definite setting of the crystal which allow the symbol to be obtained at once from the angles φ and ς, and thus comparison of differently developed crystals can be easily made.

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitsch. f. Kryst., xxi, pp. 210–232, 1893.

Universal Goniometer.—A very similar instrument to the Goldschmidt goniometer just described is the *Universal goniometer* invented by von Federow.[3] In this instrument the telescope is also the collimator, the signal being located in the side of the telescope and its image reflected to the crystal face by means of a prism. When the face is normal to the axis of the telescope the image is reflected back over its own path and brought to a focus on the cross hairs which are located just behind the prism. The credit for priority in the important invention of the goniometer with two circles, and the method of measuring crystals by the location of the poles of their faces, clearly belongs to v. Federow, as a short description of his instrument was published in the Russian language in 1889.[4] It is impossible in this space to review so important a paper as the one under consideration. It is a treatise of some 140 pages on the calculation and projection of crystals from measurements with the universal goniometer. It contains suggestions for the renaming of crystal forms and the modification of the Miller's symbols in the interests of greater uniformity in the system.

Miers's Inverted Goniometer.—Miers[5] has modified the Fuess goniometer with horizontal circle in such a way as to have the crystal held at the lower instead of the upper end of the axis of the instrument, and hence below the disc. The crystal may be measured immersed in a liquid which is contained in a rectangular trough with plate glass sides. The collimator and telescope tubes are placed at right angles to one another, their axes being also normal to adjacent sides of the trough. The liquid in the trough may be a concentrated solution of the crystal's substance, so that changes in the form of the crystal during growth may be observed and measured. The trough is supported on a small table which can be raised or lowered at will. Some very important observations which Miers has made with this instrument will be reviewed in another place.

New Goniometer Lamp.—Goldschmidt[6] describes a new goniometer lamp which he has found useful also for photo-micrographic work. The burner is an Auer or Welsbach burner (Auer'sche Glühlicht) which is specially suited to the purpose because of its strong and

[3] Zeitsch. f. Kryst., xxi, pp. 574–714, 1893.

[4] Verhandl. k. mineral. Gesellsch. St. Petersburg, xxvi, pp. 458–460, November, 1889.

[5] Nature, l, pp. 411–412, Aug. 23, 1894.

[6] Zeitsch. f. Kryst , xxiii, pp. 149–151, 1894.

steady character and its low temperature. The burner with its glass chimney is enclosed in a cylindrical mantel constructed of brass and sheet iron, in which are inserted two horizontal tubes perpendicular to one another and at the level of the brightest part of the light. One of these tubes serves to illumine the signal, while through the medium of an arm carrying a mirror on a universal joint the light from the other tube may be thrown at will on the crystal, the vernier, or the paper.

Darkening Attachment for the Goniometer.—Traube[7] has devised a very simple attachment for the Fuess goniometer with horizontal circle by means of which the crystal under measurement is protected from all light except that which comes from the collimator. The attachment is easily adjusted and quickly removed, and is so effective that measurements may be made at any hour of the day in an undarkened room. The frequent alternation of light and darkness which is so trying to the eye can thus be avoided.

Lecture Microscope.—Fuess[8] has designed a simple form of petrographical microscope adapted to the lecture room, where it can be passed from hand to hand by the students. With full set of accessories the instrument costs in Germany 158 marks.

Czapski's Ocular.—Czapski[9] considers the attachments on petrographical microscopes which have been devised for quickly changing from parallel to convergent polarized light, as quite unnecessary complications of the instrument, since the same results can be obtained by the use of the modern iris diaphragm below the condenser. To observe the interference figure of a very small crystal which only partially covers the field of the microscope, Czapski's method is to bring the crystal as near as possible to the middle of the field, remove the ocular, and place a diaphragm with small aperture over the microscope tube. With the aid of a weak lens one sees within this aperture the real image of the crystal. The crystal is now brought more accurately to the centre so that it occupies all of the now diminished field. Removing the lens one sees the best possible interference figure from the crystal.

He has devised specially for this work an ocular with an iris diaphragm at its lower end and an easily removable lens or a Ramsden's ocular above.

[7] Neues Jahrb. f. Mineral., etc., 1894, (ii), pp. 1–2.
[8] Neues. Jahrb. f. Mineral., etc., 1894, (ii).
[9] Zeitsch. f. Kryst., xxii, pp. 158–162, 1894.

Klein's Lens with Micrometer.—Becke[10] has designed an attachment to fit over the Czapski ocular like the common form of analyzer, to determine the size of the optical angle in very small crystals when the section is approximately normal to a bisectrix (Mallard's method). This device has fitted into its upper part, so as to be adjustable by friction, an aplanatic lens magnifying eight times. Below this is an ocular micrometer which can be raised or lowered by means of two heads on the outside of the attachment. The interference figure observed with this instrument is not the one obtained by the objective alone but the one formed in the upper eye point of the microscope above the Ramsden's ocular. Before using the attachment the minute crystal is centered and the diaphragm of the Czapski ocular closed until the crystal alone is visible. The Klein lens is now adjusted over the ocular till the objective diaphragm is visible, when the interference figure may be distinctly seen. The micrometer is now adjusted to read without parallax. The constant K of the combination (in Mallard's formula $\sin\delta = K.\ d$) for a given length of tube is obtained by measuring d in the case of several sections normal to a bisectric whose optical angle has been determined by an axial angle apparatus. The attachment can also be used to measure the azimuth of any point in the interference figure with reference to cleavage or twinning line, etc. The long middle line of the micrometer is placed in the azimuth of the point to be determined. On introducing the Bertrand lens and slightly altering the length of the tube the image of the section appears. The stage is now revolved until any direction desired is brought parallel to the micrometer line and the angle measured. This device is useful to determine the changes in optical orientation in different parts of a crystal individual and to determine the position of the optic axes in the twinned lamellæ of the plagioclases.

WM. H. HOBBS.

[10] Min. u. petrog. Mittheil., xiv, pp. 375–378, 1894.

GEOLOGY AND PALEONTOLOGY.

Relations of Devonian and Carboniferous Faunæ.—Prof. H. S. Williams calls attention to the recurrence of Devonian fossils in strata of Carboniferous age in northwestern Arkansas. The fossils occur in a limestone formation, about the equivalent of the Warsaw or St. Louis formations of Missouri, and referred to the lower third of the Carboniferous. Among the undoubted carboniferous forms occur numerous specimens of *Liorhynchus quadricostatum* Vanuxem and *Productella lachrymosa* var. *stigmata, onusta*, etc., Hall. The entire fauna is closely allied to that of the Eureka District, Nevada, and of Shasta County, California, and the author accounts for the appearance of these Devonian species in the Arkansas Carboniferous rocks as a case of migration from the region where they had been living unchanged. This migration was brought about by an elevation of the western area sufficient to cause a diversion of ocean currents and the shifting of such species as endured the transport into the Mississippi Valley.

In conclusion, Prof. Williams points out that during late Devonian and early Carboniferous time in the Appalachian province, diversity and alteration of deposits is marked by numerous successive and distinct faunas, in the western continental province uniformity of prevailing calcareous sedimentation for long periods is marked by an abnormally long continuance of many of the Devonian species, while the central continental province, midway between the two, is marked by the recurrence of Devonian species far up in the midst of Carboniferous sediments. This series of observations is confirmatory of the hypothesis that persistence of species without modification is associated with continuance of uniformity of conditions of environment, and that change in the successive faunas of geological time is associated with the change and rearrangement of the conditions of environment to which the fauna is subjected. (Am. Journ. Sci., Feb., 1895.)

Characters of Glossopteris.—A fortunate discovery of a specimen of Glossopteris, a fossil plant associated with the coal-bearing rocks of the southern hemisphere, near Mudgee, N. S. W., shows the attachment of the fronds to the caudex, bringing to light the following facts:

The leaves were successively developed along the whole course of the stalk and were deciduous. They were both petiolate and sessile.

The leaf scars were ovo-rhomboidal, and to each there appear to have been three bundles of vessels.

In consequence of this discovery, Mr. Etheridge reviews the history and structure of Glossopteris, giving its range in Australia, and points out its relation to allied genera. (Proceeds. Linn. Soc. N. S. W., Vol. ix, 1894.).

Geological History of the West Indies.—Mr. Charles T. Simpson gives a brief history of the West Indian archipelago since Eocene times, basing it upon a study of the molluscan fauna of that region. He premises his remarks with the statement that a considerable portion of the land snail fauna of the Greater Antilles seems to be ancient and to have developed on the islands where it is now found, while that of the Lesser Antilles has resulted from migration mostly from South America. The distribution of the terrestrial and fluviatile molluscan fauna is carefully worked out and presented in tabular form. From the facts collated the author deduces several interesting conclusions which he recapitulates in the following form.

"There appears to be good evidence of a general elevation of the Greater Antillean region, probably some time during the Eocene, after most of the more important groups of snails had come into existence, at which time the larger islands were united, and there was land connection with Central America by way of Jamaica and possibly across the Yucatan Channel, and there was then a considerable exchange of species between the two regions. At some time during this elevation there was probably a landway from Cuba across the Bahama plateau to the Floridian area, over which certain groups of Antillean land molluscs crossed. At this time it is likely that the more northern isles of the Lesser Antilles, which seem to be volcanoes of later Tertiary and Post-Pliocene date, were not yet elevated above the sea, or, if so, they have probably been submerged since. After the period of elevation there followed one of general subsidence.

"During this the island of Jamaica, as the character of its land snail fauna shows, as well as the depth of the channel between it and Haiti, was first to be isolated, then Cuba, and afterwards Haiti and Puerto Rico were separted. The connection between the Antilles and the mainland was broken, and the Bahama region, if it had been previously elevated above the sea, was submerged, the subsidence continuing until only the summits of the mountains of the four Greater Antillean islands remained above water. Then followed another period of elevation, which has lasted, no doubt, until the present time,

and the large areas of limestone uncovered (of Miocene, Pliocene and Plistocene age) in the Greater Antilles have furnished an admirable field for the groups of land snails that survived on the summits of the islands. The Bahamas have appeared above the surface of the sea, either by elevation or growth, and have been peopled by forms drifted from Cuba and Haiti, and a number of land and fresh-water species have been recently colonized in South Florida, probably since the Glacial epoch. (Proceeds. U. S. Natl. Mus., Vol. xvii, 1894.)

Fossil Mammals of the Lower Miocene White River Beds.—A part of the collection made in 1892 for the American Museum at New York by Dr. Wortman, has been made the subject of a paper by the collector in conjunction with Prof. Osborn of Columbia College. The novel points presented are:

1. New characters of the Lower Miocene Rhinoceroses, including two new types, *A. trigonodum* and *A. platycephalum.*
2. The osteology of *Metamynodon.*
3. The basioccipital characters of *Oreodon* as developed in successive horizons.
4. The determination of two species of Anthracotherium, and additional characters of the American *Hyopotamus.*

An importantant adjunct to the paper is a tabular statement of the succession of species in the White River Miocene. (Bull. Am. Mus. Nat. Hist., 1894.)

Geological News.—ARCHEAN.—According to Prof. H. P. Woodward, the Archean rocks are more largely developed in Western Australia than in any other portion of the world. The series is highly contorted, being folded into a number of parallel folds striking north and south. These folds form naturally six distinct belts which differ in the character of the rocks. Beginning at the west, the first belt is composed of comparatively soft rocks, intersected by dikes of diorite and granite, and veins containing lead, copper, zinc and iron. The second belt is of hard, crystalline rocks also intersected by granite dikes, and but few mineral bearing veins. The third is a granite belt, absolutely destitute of mineral veins. The fourth, fifth and sixth are rich in gold, iron and copper. (Geol. Mag. Dec., 1894.)

PALEOZOIC.—According to Mr. Walcott, the oldest Cambrian fauna known in western United States is found in the White Mountain range of Inyo County, California, where the author traced a coral

reef (Archæocythinæ) for nearly thirty miles. (Am. Journ. Sci., Feb., 1895.)

Prof. N. H. Winchell considers the Galena limestone only a phase of the Trenton, intensified in the typical locality, and fading out in all directions. The physical break and faunal change which follow it in the northeast are the probable parallels of those which mark the transition from the Trenton to the Hudson River. (Am. Geol., Jan., 1895.)

A specimen of the new fossil shark, *Cladodus clarkii*, recently fonnd in the Cleveland shale of northern Ohio shows the dentition in a remarkable manner by reason of some fortunate fractures. The new specimen confirms most of the characters previously published, and adds a few not discoverable in former fossils. It is described and figured by Prof. Claypole. (Am. Geol., Jan., 1895.)

Recent examinations of the "elephant rock," occurring in various parts of the Transvaal prove it to be a dolomite. Mr. Draper, to whom the rocks were submitted, states that this dolomite is of great extent in the Transvaal and Namaqualand, and he is of the opinion that the limestone tufa, now occupying large areas in the drainage basin of the Vaal and Orange Rivers, are derived from the dolomite. (Quart. Journ. Geol. Soc., Nov., 1894.)

BOTANY.

Some Botanical Collections.—That most valuable distribution, Ellis and Everhart's "North American Fungi" has recently completed its thirty-second century, carrying the total number of specimens up to 3200. On looking over the alphabetical index one notes especially that this century includes of *Cercospora*, 8 species; *Cylindrosporium*, 3; *Gloeosporium*, 3; *Microsphæra*, 2; *Phyllosticta*, 5; *Puccinia*, 5; *Septoria*, 6; *Uredo*, 3; *Uromyces*, 2; *Ustilago*, 1.

The uniform, and well-known excellence of the specimens in this distribution, needs no further words of commendation here. Those who can not obtain this set should hasten to secure the second edition which bears the name of "Fungi Columbiani."

F. S. Collins, Isaac Holden and W. A. Setchell propose soon to begin the publication of North American algæ under the title of "Phycotheca Boreali-Americana." The first fascicle of 50 specimens will contain species of *Oscilliaria*, *Lyngbya*, *Calothrix*, *Monostroma*, *Ulothrix*, *Drapanaldia*, *Rhizoclonium*, *Caulerpa*, *Lemanea*, *Chondria*, *Polysiphonia*, *Microcladia*, etc. It is intended "to include all families of algæ, both fresh-water and marine, except that no provision has yet been made for diatoms, desmids or charads," but the authors state that these "may be included later." This work will be truly North American, including the whole continent and its adjacent seas from the Arctic Ocean to the Isthmus of Panama, and the West India Islands. The low price (five dollars per fascicle) places it within reach of every college botanical department. Those interested should apply to Frank S. Collins, Malden, Mass.

Josephine E. Tilden of the University of Minnesota has begun the distribution of the fresh-water algæ of the upper Mississippi Valley. It will be important as supplying for the first time a series of these plants from a new region. For century I the price is ten dollars.

The Flora of Amador, Calaveras and Alpine counties, California, is offered to the public in sets of prepared specimens at seven dollars per hundred by George Hansen of the Experiment Station at Jackson, California. The sets are said to contain many varieties and novelties.

Professor F. L. Harvey, of Orono, Me. proposes to issue sets of the Weeds and Forage Plants of Maine, embracing about 300 species. They are intended especially for the use of schools and "granges", and are sent out mounted and labeled. The moderate price (ten dollars per

hundred) should place them in every high school in Maine, as well as in the herbaria of many of the agricultural colleges in other states.

Professor Penhallow, of Montreal, Canada, has prepared a "Type Series of North American Coniferæ," consisting of microscopical sections of the wood, stained, and mounted in balsam. Each species is represented by transverse, radial and tangential sections. The series contains 264 slides and is sold at $120.00. It is the outgrowth of studies made by Professor Penhallow upon North American Conifers looking to a classification based upon the anatomy of the wood. The results of these studies are to be published shortly, and will add to the interest of the prepared specimens.

We have already noticed A. H. Curtiss's "Second Distribution of Plants of the Southern United States," of which Series I and II are now ready. (February NATURALIST).

Fascicle I of Arthur and Holway's "Uredineæ Exsiccatæ et Icones" gives promise of being a most valuable addition to the carefully studied sets of plants now offered to botanists. The specimens are excellent and the drawings very carefully made. A feature which is to be commended is the uniform magnification throughout the series. In the present fascicle seventeen species, are represented by thirty-one specimens and one hundred and thirty-five figures. When supplied in loose packets the cost is to be three dollars per fasicle, when in bound volumes, fifty-cents more.

Many botanists have in the past few years received the neatly prepared sets of lichens sent out by C. E. Cummings and A. B. Seymour under the title of "Lichenes Boreali-Americani," of which about 150 numbers have been received. Hereafter T. A. Williams will aid the editors named above. This distribution has been so well patronized that a second edition has been prepared.

Professor Underwood's "Hepaticæ Americanæ," constitutes the only recent set of North American liverworts. Although no specimens of this distribution have been received for some time we trust that it is to continue.

The distribution of North American Characeæ ("Characeæ Americanæ Exsiccatæ") by Dr. T. F. Allen, of New York City (No. 10 East 36 St.) possesses unusual value, since it probably represents more than any other the immediate results of a critical revision of the species. A recent fascicle contains twelve species mainly of the genus *Nitella*. With these American species there were distributed seventeen Japanese species and varieties under the title of "Characeæ Japonicæ Exsiccatæ,"

among which were several of the new species recently described in the *Torrey Bulletin*.

All mycologists who are familiar with the excellent specimens of Sydow's "Uredineen," (published in Berlin), which has now reached its eighteenth fascicle, (900 specimens) will welcome the beginning of a new set by the same author devoted to the *Ustilagineæ*. Fascicle I of this new set "Ustilagineen," containing fifty specimens appeared within a few months.

We should not overlook here the two centuries of "New York Fungi" published by C. L. Shear, heretofore noticed in this journal. The excellence of the specimens commends this collection, especially to those who are beginning the study of the larger fungi (*Hymenomycetæ*) to which it is mainly devoted. We understand that Century III is nearly ready for distribution.

Nor must we omit the useful "Economic Fungi" published by A. B. Seymour and F. S. Earle, of which seven fascicles (of about 50 species each) have appeared. The work deserves to be successful.

We do not know whether the "Uredineæ Americanæ," of which one fascicle was issued a year or so ago by M. A. Carleton, is to continue or not. It certainly made a good beginning.

We may add to the foregoing the distribution of "Canadian Lichens," and "Canadian Mosses" by John Macoun of the Canadian Geological Survey, which contain good specimens, neatly prepared and often of much interest on account of the region from which they were obtained.

Verily the tribe of makers of exsiccati is a numerous one, and were we to include all those devoting themselves to supplying plants of particular regions, it would be increased three or four fold.—CHARLES E. BESSEY.

Some Recent Botanical Papers.—Dr. T. F. Allen's valuable work, "The Characeæ of America," has made progress by the issuance of another fascicle containing descriptions and illustrations of nine species of *Nitella* of which three are new to science. Too much praise can not be given to the industrious author, who for love of Science, brings out, from time to time, the successive parts of this first work on a group hitherto little studied in this country.

Ellis and Everhart have added a convenient Analytical Key to their *North American Pyrenomycetes*, which has hitherto lacked that useful portion. The same authors have recently distributed a reprint from the proceedings of the Academy of Natural Sciences of Phila-

delphia (65 pp.) containing descriptions of new species of fungi from various localities. Of these there are Hymenomycetes, 10 species; Pyrenomycetes, 72; Discomycetes, 22; Sphaeropsideæ, 91; Hyphomycetes, 46; or a total of 241.

"The Special Senses of Plants" is the title of a thoughtful and suggestive paper by Dr. J. C. Arthur, published in the Proceedings of the Indiana Academy of Sciences. The author discusses gravity sense, light sense, moisture sense, heat sense, and contact sense. The paper should be read by every teacher, whether he teach botany or not.

Professor Penhallow's paper, "Observations upon Some Structural Variations in Certain Canadian Coniferæ" in the Transactions of the Royal Society of Canada, contains histological discussions pertaining to *Pseudotsuga douglasii, Larix occidentalis, Pinus ponderosa* and *Pinus albicaulis.* It is illustrated by four plates containing nineteen figures.

The always welcome Annual Report of the State Botanist of the State of New York has recently been received. As usual it shows that the flora of a region as well worked as that of New York contains many hitherto undescribed species, mostly of the lower plants, but one flowering plant (a *Carex*) proves to be new.—CHARLES E. BESSEY.

ZOOLOGY.

The Central Nervous System of Teleosts.—In the last number of La Cellule, a preliminary paper by Van Gehuchten on the central nervous system of the trout[1] adds several points of considerable interest to our already large stock of knowledge of the structure of the nervous system of vertebrates as determined by the epoch-making Golgi methods. Its value, and that of other papers by competent students, lies not only in adding so much to the known facts concerning the lower vertebrates, but more especially in the light that it throws upon obscure points in the cerebral structure of the higher animals and of man, where the central organs are so large and complex as to render investigation very difficult and even impossible. The older writers, Stieda, Fritsch, Rabl-Rückhardt, Edinger and others, concerned themselves almost wholly with the homologies of the brain of Teleosts. It was not until 1887 that the Golgi method was first employed with them by Fusari. Since then, Schaper, P. Ramon and Retzius have used it. And, if to their work we add that of Nansen and Retzius on the nervous system of *Petromyzon* and that of v. Lenhossek on that of *Pristiurus*, the list will be almost complete for fishes in general.

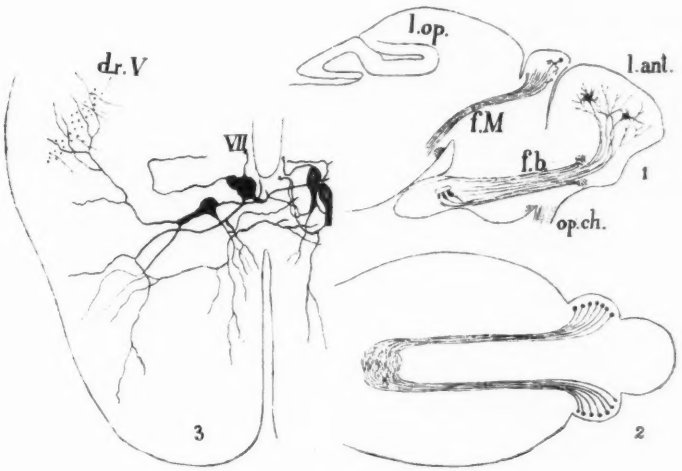
Van Gehuchten takes up (1) the structure of the anterior lobes, which, by the way, are homologous, as shown by Rabl-Rückhardt, with the caudate and lenticular nuclei only of the human brain; (2) the origin of the fibres of the cerebral peduncle; (3) the origin and termination of the fascicle of Meynert; (4) some of the constituent elements of the optic lobes; (5) the origin and termination of the olfactory fibres; (6) the origin of the *oculomotor communis;* (7) origin of the facial nerve; (8) the origin and the peripheral and central terminations of the auditory nerve; (9 and 10) the elements of the Gasserian ganglion, of the trigeminal nerve and of the large ganglion in the course of the pneumogastric, as also of the arrangement of the fibres of these in the cerebral trunk.

Regarding the anterior lobes and the cerebral peduncle, the most important fact brought out is that the latter is composed of both ascending and descending fibres, or, to use the terminology recently proposed by Fish, neurites. The former cannot therefore be regarded with

[1] Le System nerveux des Téléeostéens, La Cellule, Vol. X, pp. 255–95, with 3 pls.

Edinger as merely ganglia for the origin of the peduncular neurites. The interlobular commissures are shown not to be compared with the anterior commissure of human anatomy where merely two opposite lobes are connected. Each of the commissures is composed of neurites that branch off from the basal peduncle and branching cross to and terminate among the protoplasmic processes, or dendrites, of the opposite lobe.

The fascicle of Meynert, which has hitherto been a great puzzle, is explained as being composed of neurites arising from cells in the *ganglia habenulæ* and terminating near the lower surface of the brain in the so-called interpeduncular body. Here they branch profusely,



KENYON ON BRAIN STRUCTURE.

Fig. 1. Longitudinal section of a trout brain passing to one side of the median line.—l.ant., anterior lobes; l.op., optic lobe; f. b., basal fascicle; c. p., cerebral peduncle; f. M., fascicle of Meynert arising from the cells in the ganglion habenulæ; op. ch., optic chiasma, behind which is the commissure of Gudden, and in front of which are the interlobular commissures. Near the fascicle of Meynert is the ansiform commissure.

Fig. 2. The fascicles of Meynert viewed from above, each ending in the interlobular body.

Fig. 3. Transverse section through the nucleus of origin of the facial nerve VII, neurite of the facial nerve; d. r. v., descending root of the fifth with its short collaterals.

mingling with one another, and come in contact with the dendrites and cells of the body. While this explains that the fascicles are composed of fibres of but one kind, nothing is known of the fibres that go to the ganglia habenulæ to complete the circuit. Hence the function of the fascicles is still an open question.

The most interesting point, besides the solution of the structure, origin and termination of the fascicles of Meynert, that appears in the paper, concerns the conductive function of the dendrites. Such a function has been denied them by Kölliker, who still maintains his original ground. His objections are based on the fact, as he states it, of there being protoplasmic processes in certain parts of the white matter of the human brain where they cannot come in contact with nerve endings. Now van Gehuchten shows that in the anterior lobes the ascending or sensory fibres from the basal peduncle terminate freely among the processes or dendrites of the cells of the descending fibres, and that there is no third cellular element between them. And, what is more to the point and of greater weight, he finds that the extremely lengthened dendrites of the cells giving rise to the facial nerve penetrate the descending root of the trigeminal from the neurites of which are given off short, fine collaterals. It has been that shown among Batrachia and elsewhere such means of completing the nervous circuit exists, but Kölliker has persisted in denying any value to these facts when man is considered. The nervous circuit may, he says, be more easily explained without the dendrites. To this van Gehuchten adds that the matter would be still more simple were the collaterals left out. But dendrites and collaterals exist and it is our business to explain them. Moreover, further study of the brain of the higher animals and of man may, and probably will, show that in those places in which Kölliker supposes none to exist, collaterals really occur, and that their not being seen hitherto is to be explained by the difficulties that beset the path of the investigator when he takes up so complex and highly-developed a structure as the human and mammalian brain.

It is with considerable force that van Gehuchten finishes his consideration of the question. From the moment, he says, that any one admits, as one must, the conductive function of the dendrites of the mitral cells of the olfactory bulb, of the cells of Perkinje in the cerebellum, of the cells of the optic lobes in birds, of the ganglionic cells of the retilia, of the pyramidal cells of the cerebral cortex, one may demand upon what decisive grounds any one can find support for a denial of the same function in the dendrites of the medulla.

—F. C. Kenyon.

New Deep Sea Fishes.—A preliminary account of new types of deep water fishes from the northwestern Atlantic is given (Proceeds. U. S. Natl. Museum, Vol. XVII, 1894) by Dr. G. Brown Goode and Tarleton H. Bean. Two new families, Cetonimidae and Rondeletiidae, represented by *C. storeri*, *C. gillii* and *R. bicolor*. The second family is distinguished from the first by the presence of ventral fins, and the incompleteness of the opercular apparatus. Both are Malacopterygian fishes, belonging to the group set aside by Gill under the name Iniomi. Only a single specimen of each species was obtained from depths ranging from 1,043 to 1,641 fathoms.

Another remarkable type belongs to the Chimaeroid group, from the existing forms of which it differs in the extremely elongate, muzzle, and the feeble claspers. Four specimens were obtained, two of them young, and with proportions shorter than those of the adults. The habitat of this genus is given as off the coasts of Virginia, Maryland and Delaware, 707 to 1,080 fathoms. It is described under the name *Harriotta raleighana*.

All the types are figured, and in the next number of the Naturalist, we will reproduce them.

Preliminary Notes on the Osteology of the North American Crotalidae.—I desire to present a preliminary paper giving some characters of the osteology of the *Crotalidae*. I have to thank Dr. O. P. Hay and Mr. M. S. Farr, Fellows in the University of Chicago, for furnishing me specimens for this work. Also, I am under obligations to Dr. George Baur, Assistant Professor in the University of Chicago for special favors and suggestions.

I am able to give both specific and generic characters of the genus Ancistrodon. The species *A. contortrix* was obtaind near Johnstown, Pa., while *A. piscivorus* was secured at Enterprise, Miss. Of the genus Sistrurus I have examined two species, namely, *S. miliarus* from Florida and *S. catenatus* from Indiana. Also I have examined two species of Crotalus, namely, *C. horridus* from Tuscarora Mountain, Pa., and also one specimen from near Johnstown, Pa., and *C. confluentus* collected in Kansas.[1] In addition, we have examined one individual each of *C. horridus* and of *S. catenatus* now in the Museum of Monmouth College. The locality of these specimens is not known.

[1] I have also examined a skeleton in the collection of the Field Columbian Museum, and labelled "*Crotalus durissus* Texas." The identification of this specimen is not at all certain, but it seems to be *C. adamanteus atrox* or *C. molossus*.

Since I have undertaken a more detailed study of these snakes, I omit from this article extended remarks on geographical distribution and specific characters. Neither have I, at this stage of my work, thought best to adopt any system of classification[2].

I desire to make a few general statements. The upper surface of the skull of *Crotalidae*, in comparison with the skulls of other snakes, is quadrate in outline. The interobital region, owing to the elevation of the outer edges of the frontals and outer anterior angles of the parietals, is concave.

The nasal bones are loosely attached. The prefrontals are quadrate in outline, movable, and are between the frontals and maxillaries. The maxillaries occupy a vertical position in front of the orbit and are attached above to the prefrontals and behind to the ectopterygoids. Each possesses a well-developed poisonous fang, and, in its outer surface, a conspicuous and characteristic pit. The parasphenoidal surface is concave and divided by a longitudinal median ridge-like process. Well-developed ventral processes are present on all the vertebræ of the body. The latter never exceed 200, the combined number of body and caudal vertebrae not commonly reaching this number.

Of the family Crotalidae the Ancistrodon shows the least specialization while the highest development is found in the Crotalus. The development of the family is shown in the following ways:

1. By the expansion and flattening of the anterior portion of the skull. This, also, takes place to a less extent in the petrosal region.

2. By the development of the maxillary fang and consequent change in the position and shape of the maxillaries and prefrontals.

3. As specialization proceeds there is a decrease in the number of teeth. Besides the fangs, no teeth are found on the maxillaries, and, except in Ancistrodon, none exist on the pterygoids posterior to their junction with the ectopterygoids.

4. The freedom and mechanical arrangement of the nasals, prefrontals, maxillaries, palatines, pterygoids and ectopterygoids is quite notable.

[2] In this brief article we shall not attempt to refer to the numerous authorities consulted However, it should be stated, perhaps, that the general osteology of the Crotalidae has been worked out and discussed by various naturalists. The results of their works have appeared in many publications and under various dates. Also, we wish to state that Peters, as early as 1862, briefly mentions the craniology of the genus Ancistrodon.

Hr. W. Peters hielt einen Vortrag uber die craniologischen Verschiedenheiten der Grubenottern (Trigonocephali) und uber eine neue Art der Gattung Bothriechis. Monatsberichte der Koniglichen Preufs. Akademie der Wissenschaften zu Berlin, 1862, p. 670.

5. The various vertebral processes increase in length and the ribs of the median portion of the body show a decided tendency to become longer, thus giving the body a spindle-shape.

6. The vertebræ of the body increase in number from Ancistrodon to Crotalus, while the caudal vertebræ show a reverse tendency. In Ancistrodon, the ratio of the body and caudal vertebræ is approximately as 4 to 1, in Sistrurus 5 to 1, and in Crotalus 7 to 1.

Ancistrodon Beauvois, 1799.

Upper surface of the petrosal region convex and not unusually extended to form a support for the squamosals. Post-orbital portion of the parietals without lateral expansions. Pterygoids toothed posterior to their junction with the ectopterygoids. Posterior ends of the ectopterygoids grooved and notched and placed in a socket formed in the upper surface of the pterygoids. Palatines either triangular or club-shaped; in the latter case, attached to the pterygoids by their more expanded ends.

Post-frontals rudimentary if present. Posterior caudal vertebræ not cöossified, i. e., end ossicle absent.[3] Number of vertebræ of the body from 140 to 154; tail 40 to 54.

Eastern and southern United States and Mexico.

Ancistrodon piscivorus La Cepede, 1787.

Outer opening of the lachrymal foramen slit-like and on the anterior margin of the prefrontal. Palatines club-shaped and their more expanded ends attached to the pterygoids.

Number of vertebræ of the body from 138 to 145; tail 30 to 48.

Ancistrodon contortrix Linne, 1766.

Outer opening of the lachrymal foramen on the anterior upper surface of the prefrontal and situated just beneath a small pointed process. Palatines small and triangular in outline, with the obtuse angle pointing upwards. According to Peters, *A. contortrix pugnax* possesses a palatine bone equiangular in outline.[4]

Number of vertebræ of the body from 150 to 155; tail 25 to 40.

[3] In the Rattlesnake, some seven or eight posterior caudal vertebræ coossify, in the process of the growth of the animal, and the bone thus formed has been variously named. J. Czermak speaks of these coossified vertebræ as "Endkorper der Wirbelsaule": see Ueber den Schallenzeugenden Apparat von Crotalus zei'schrift fur wiss. Zoologie. Bd., VIII, p. 294, 1857. Hoffman accepts the name given by Czermak: see Dr. H. G. Bronn's Klassen und Ordnungen des Thier reichs. Sechster Band. III, Abtheilung. Reptilien, III, p. 1417, 1890. Garman calls this bone the Shaker: see On the Evolution of the Rattlesnake. Proc, Bos. Soc. Nat. Hist, Vol. XXIV, 1889.

[4] Loc. cit., p. 673.

Systrurus Garman, 1883.

Lateral expansion of the petrosal region slight. Squamosal short and its posterior end widened into a hook-like process for the attachment of the quadrate. Pterygoids not toothed posterior to their junction with the ectopterygoids and their posterior expanded portions more curved than in other genera. The ectopterygoids are grooved for the reception of the pterygoids. However, their posterior ends are not notched, as in Ancistrodon, but are attached to the pterygoids for a much greater length than in either of the remaining genera. The palatines are triangular and attached to the pterygoids at the acute angle, the obtuse angle being nearer the anterior end of the palatines. Postfrontals rudimentary. Posterior caudal vertebræ cöossified, i. e., end-ossicle present.

Number of vertebræ of the body from 130 to 153; caudal vertebræ from 20 to 35.

United States and Mexico.

I omit the specific characters until opportunity is offered for the study of a wider range of specimens.

Crotalus Linne, 1758.

Petrosal region expanded and the outer edge of the petrosal slightly upturned so as to form a support for the squamosal. The parietals possess clearly marked lateral expansions which connect with the anterior ends of the petrosals. Squamosals relatively more curved than in other genera, not hooked, but their posterior ends expanded. Pterygoids not toothed posterior to their junction with the ectopterygoids.[5] Posterior ends of the ectopterygoids grooved but not notched, and the pterygoids not notched for the reception of the ectopterygoids. The palatines are club-shaped and attached to the pterygoids by their more pointed ends. The postfrontals are well-developed, border the orbital surface of the parietals, and connect with the frontals. The posterior caudal vertebræ are coossified, i. e., possess a well-developed end-ossicle.

Number of vertebræ of the body from 165 to 187; tail from 19 to 32.

United States, Mexico and Brazil.

Explanations of Plates.

Fig. 1.—Squamosal of *A. piscivorus.*

Fig. 2.—Squamosal of *A. contortrix.*

Fig. 3.—Squamosal of *S. catenatus.*

[5] If Dumeril's plates be correct, *C. durissus* does not agree in this respect: see Prodrome de Classification des Ophidiens, 1852. Planche 2, Figs. 14 and 15.

Fig. 4.—Squamosal of *C. confluentus.*
Fig. 5.—Squamosal of *C. horridus.*
Fig. 6.—*A. piscivorus.* a, Pterygoid; b, Ectopterygoid; c, Palatine.
Fig. 7.—*A. contortrix.*
Fig. 8.—*S. catenatus.*
Fig. 9.—*C. confluentus.*

—W. Edgar Taylor.
Acting Professor of Biology, Monmouth College, Monmouth, Illinois.

Zoological News.—Pisces.—The little-known Agonoid Fish, *Hippocephalus japonicus*, is described by F. Cramer. The description is based on an alcoholic specimen presented to the California Academy of Sciences by Dr. Krause, of Berlin. The specimen is 360 mm. long, and was obtained in the Okhotsk Sea. (Proceeds. Cal. Acad. Sci., Ser. 2, Vol. IV, 1894.)

Mammalia.—The Price collection of mammals from southeastern Arizona, and the Granger collection from South Dakota, recently acquired by the American Museum of New York, include a number of new forms, ten of which are described by Dr. J. A. Allen. The collections and the observations of the collectors greatly extend the recorded range of many species of mammals. (Bull. Am. Mus. Nat. Hist., 1894.)

A collection of mammals sent to the American Museum from New Brunswick, numbers about 250 specimens, and contains representatives of several species worthy of note, among which are two specimens of *Synaptomys cooperii* Baird. This is the first record of the genus Synaptomys from New Brunswick. (Bull. Am. Mus. Nat. Hist., 1894.)

In the annotated list of Florida Mammals prepared by Dr. F. M. Chapman, four orders are represented, as follows: Glires, 27; Chiroptera, 10; Insectivora, 4; Carnivora, 12. (Bull. Am. Mus. Nat. Hist., 1894.)

EMBRYOLOGY.[1]

Sexually Produced Organisms without Maternal Characters?—When it was announced by Boveri[2] than an organism might be formed from a fragment of an egg fertilized by sperm of another species and then possess only the characters of that latter paternal species, this fact naturally gave rise to much speculative application, and was welcomed as evidence of the great value to be set upon the nucleus in the processes of heredity. Boveri stated that bastard larvæ formed by sperm of *Echinus microtuberculatus* and eggs of *Sphaerechinus granularis* were in all respects middle forms between the species. He also stated that when the eggs of the latter species were shaken so that they broke and lost their nuclei and were then fertilized by the sperm of the former, dwarf larvæ were formed that had the characters of the male parent, Echinus, only, and not those of the female parent, Sphærechinus. Thus, he concluded, the male sperm nucleus transmitted paternal characters, while the egg protoplasm, deprived of its nucleus, gave none of the maternal characters to the offspring.

Oswald Seeliger[3] has repeated these experiments with the same species and has shown that Boveri's conclusions are not the necessary ones to be drawn from the evidence, but only interpretations that ignore most weighty factors.

In two plates he gives careful figures of the larvæ of both species at the same stages and also figures of the bastard larvæ. An examination of these convinces one that the normal bastards, or those from whole eggs, are not by any means exactly intermediate between the two parents in all cases. Many do combine the parental characters in this way, but many are much like the father and others more like the mother. This holds both for the general shape and for the structure of the larval skeleton.

Since then, many bastards from whole eggs resemble the father, there is no proof that the bastards from broken eggs were not also from nucleated pieces, for it must be borne in mind, that Boveri failed to get larvæ from isolated fragments, and obtained his dwarf larvæ from the

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] See American Naturalist, March 1, 1893.

[3] Roux Archiv. f. Entwicklungsmechanik. I, 2, Dec. 11, '94.

general mixture of nucleated and non-nucleated fragments that are to be found when the eggs are shaken in a test tube.

Boveri also observed that the dwarf larvæ had small nuclei, coming as he supposed from the male nucleus only, not from two fused nuclei as in ordinary fertilization. This reason is also fallacious since Seeliger finds a great deal of variation in the size of the nuclei in the normal bastards from whole eggs. The small nuclei may come, then, from eggs with nuclei and do not give any evidence as to the absence of a nucleus in the egg fragment.

Again the bastards from the whole eggs vary much in size. In shaken eggs, however, Seeliger finds dwarf larvæ much more numerous than in the case of whole or unshaken eggs.

He concludes that though the fertilization of non-nucleated egg fragments may not be impossible, it is probable that the dwarf larvæ obtained by Boveri were merely the results of fertilization of broken eggs or egg fragments still retaining their nuclei.

Double Monsters.—To the same number of Roux's new periodical, Professor O. Schultze, of Würzburg, contributes some interesting results that he obtained by keeping frog's eggs in a forced position. The eggs of *Rana fusca* were fastened to glass slides and then fertilized and fixed between slides so that they could not revolve when turned upside down.

They were allowed to develop right side up till divided into two cells and then inverted and kept upside down till towards the beginning of gastrulation.

A detailed account of the methods and of the results of individual experiments is given.

It appears that a considerable number of the eggs thus exposed to the disturbing effects of gravitation developed into double monsters of various characters as shown in the two plates. Some developed two heads and two sets of gills on each.

The formation of these double individuals in place of the normal single one, is in some way due to the rearrangement of the substance of the cells when inverted and acted upon by gravity, so that the heavier part is drawn down and the lighter rises, as may be readily seen since it is dark colored. There is thus a modification of the egg substance that acts like a partial division of the egg and allows each of the two cells to develop somewhat as if isolated.

In a discussion of the general question of the formation of double monsters in nature, the author rejects the idea that abnormal or mul-

tiple fertilization is concerned or that subsequent events are the cause. The cause of double monsters lies in some abnormal state of the ovarian egg. This state of the egg may be like that that has in recent experiments produced double formations from half eggs; that is, the abnormality may be its division into more or less separate halves, each of which would form a complete individual if separated from the other.

Double individuals are thus to be regarded as coming from imperfectly divided ovarian cells; eggs similar to the somatic cells that are found with two nuclei. A complete division of the germ material produces separate individuals, a very slight division, double monsters; between these extremes are identical twins.

The formation of double monsters would be, in this speculation, a process of arrested development!

Fusion of Blastomeres.—Dr. Arnold Graf[4] briefly describes a remarkable case of retrogressive cleavage in the eggs of the sea-urchin Arbacia.

Some eggs compressed under a cover-glass after the method of Driesch, divided into flat plates of 16 cells that quickly passed into 32 (here some abnormal conditions may be suspected). When the pressure was removed by adding more water, the cells began to fuse so that their number became reduced to 15 and then 14! At first each has two or three nuclei according as it is made by the fusion of two or of three cells, but later the nuclei fuse and the cells change their positions and shapes. The same phenomenon was seen in a plate of 8 cells.

It is claimed that only those cells unite that are closely related: the daughter cells of one mother cell fuse together.

Unfortunately nothing is known of the possible future of such embryos nor of the effective causes at work in producing them, and so this notice serves more as a stimulus to work than as a contribution to our knowledge of the mechanics of embryology.

Temperature and Development.—Professor O. Schultze[5] finds that the eggs of *Rana fusca* may be kept in water at 0° C for 14 days when in the gastrula stage without losing the power to form normal embryos. During this period there is a complete cessation of development.

[4] Zool. Anz., XVII, Dec., 1894.

[5] Anat. Anz., X, Dec. 19, 1894.

These results are opposed to those of O. Hertwig who found that exposure to 0° C injured the eggs so much that they would not develop.

A Problematical Structure in a Mammal.—Dr. A. W. Weysse[6] in a very careful and well illustrated study of some thirty blastodermic vesicles of the pig, finds a remarkable ectodermic outgrowth arching over the germinal disk. The cavity beneath this "bridge" is never closed, and is eventually obliterated by the fusion of the "bridge" cells with the subjacent ectoderm.

The author thinks this structure has no homology in any thing as yet known among mammals, but may, perhaps, be compared to the dorsal growth in Amphioxus that forms the medullary canal, since they both agree in time of formation and in relations to the neurenteric canal and neuropore!

Development of Scyphomedusæ.—Ida H. Hyde has published the results of a most careful examination of the cleavage, gastrulation and the formation of the scyphistoma stage in several medusæ. The paper is illustrated by more than one hundred very careful and true figures and bids fair to clear up some much disputed points upon which the most noted investigators have held different views.

The material was obtained at Annisquam, Mass., at Eastport, Maine and from Johns Hopkins Marine Station in Jamaica, and was studied at Bryn Mawr, Woods Hole and Heidelberg.

The embryology of *Aurelia marginalis* from Jamaica had never before been studied; that of *A. flavidula* and *Cyanea arctica* had been, imperfectly.

The gastrulation of *A. marginalis* differs from that of all known Scyphomedusæ in that it is a process of delamination, that is, the blastula becomes converted into a closed two-layered larva by the division of some cells in such a way that their inner ends form an inner layer.

In *A. flavidula* the germ layers are formed in two different ways: eggs from Eastport, Maine, gave rise to the entoderm by a process of delamination combined with inwandering of cells from various parts of the blastula wall; eggs from Annisquam formed invaginate gastrulas.

In *C. artica* the gastrulation is a modified invagination in which some cells break loose from the pole that is invaginating; there is, however,

[6] Proc. Amer. Acad. Arts & Sci., XXX, 1894.

no trace of the multipolar inwandering of cells as described by McMurrich.

In the formation of the Scyphistoma it is found that the planula of *A. marginalis* settles down by the aboral pole which is peculiarly modified.

In all the species examined the mantle is a new formation and not a reopening of a gastrula mouth.

The inrolled part of the ectoderm remains as the œsophagus, and is not invaginated again, so that there is no doubt of the correctness of the views held by Goette regarding the ectodermal nature of this part of the digestive cavity.

The first pair of gastric pouches arises as a pair of outgrowths from the entoderm, but the second pair comes from the ectoderm.

The ectoderm thus takes part in the formation of the œsophagus, the septa and the gastral filaments as well as the second pair of the four original pouches.

Goette's views as to the relation of the Hydromedusæ and Anthozoa are thus strengthened by these observations.

Blastomeres of Medusæ.—Raffaello Zoja, of Pavia, has published a preliminary notice[7] of some most interesting work upon the development of isolated blastomeres of Medusæ and of other non-vertebrates. He finds that even $\frac{1}{16}$ of an egg, that is, one of the isolated cells when the eggs has divided into 16, is able to develop by itself into a perfect organism; it develops in the same way as a complete egg and forms as perfect an individual.

In *Clytia flavidula* $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ or $\frac{1}{16}$ when isolated develops into a hollow blastula in which entoderm arises by migration. A larva results that differs from the normal whole-egg-larva only in size. In the case of $\frac{1}{2}$ or $\frac{1}{4}$ egg the hydroid form was ultimately obtained. The larva probably has half as many cells as in the normal case.

In *Laodice cruciata* also $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ or $\frac{1}{16}$ of the egg will grow into a perfect, but small swimming larva.

In *Mitrocoma annæ* $\frac{1}{2}$ or $\frac{1}{4}$ of the egg gives rise to a perfect larva. In *Liriogie micronata* one of the first two or the first four blastomeres may form by delamination a larva with ectoderm and entoderm. In the former case a medusa with the symmetrically arranged tentacles of the adult may result!

The isolated pieces of medusæ eggs develop like the whole egg and not like parts regenerating the rest.

[7] Anatomischer Anzeiger X, Oct., 1894.

Cleavage in the eggs of medusæ thus seems to be a quantitative and not a qualitative process.

Development in Rarified Air.—Professor C. Giacomini[8] has devised an apparatus by which hen's eggs can be subjected to diminished pressure during incubation. The results presented in this preliminary communication are that a pressure of 16 to 17 cm. prevents the normal formation of the vascular organs and incites various monstrosities in the early days of development besides much retarding all the processes of growth.

In later stages embryos are killed by air at that low pressure. These effects seem due to the state of oxygen in the air as they are counteracted by the addition of oxygen to the rarefied air.

The author hopes to have discovered a valuable new aid in the investigation of experimental teratology.

[8] Archiv. Ital. de Biologie, XXII, Dec. 11, 1894.

PSYCHOLOGY.[1]

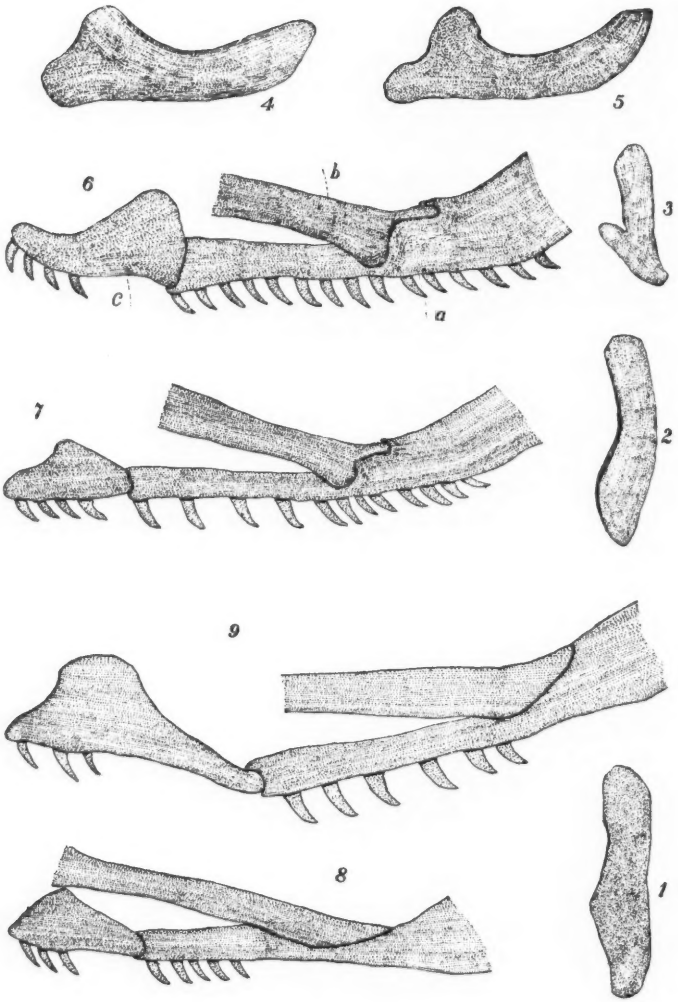
The Present State of Psychology.—At a meeting of the American Psychological Association, held at Princeton during the Christmas holidays just past, Dr. Patton, the eminent President of Princeton University, made an address of welcome to the assembled psychologists in course of which he reminded them that psychology was originally a branch of philosophy as distinguished from science, and urged them never to forget this fact and not to reduce psychology to the level of a mere science.

One, at least, of Dr. Patton's hearers, found his doctrine hard to accept. That psychology has been a part of philosophy all will admit, and, in whatever sense we take that much misused word, it is hard to believe that the time will ever come when the philosophical significance of the facts which it is the province of psychology to observe, and of the laws which she is bringing to light, will be ignored by the thoughtful. There is probably no psychologist so devoted to what Professor James wittily calls "the pendulum and chronoscope philosophy," or so sceptical as to the value of current philosophical theories, as to deny that psychology is to be an important part of the coming philosophy. But this is not, I think, what Dr. Patton had in mind.

For some generations "science" and "philosophy" have been regarded as distinct branches of human activity, and there has been little friendly commerce between their representatives. "Science" is that organized body of knowledge got by observation, experiment and demonstration. The spirit of pure curiosity to which we owe it, is a comparatively new momentum in man's intellectual life. Only in the last three centuries have its greatest discoveries been made. By "philosophy" we commonly understand those ancient disciplines in which the methods of the newer knowledge have been, as yet, but little used. Such are the sciences that deal with the facts of consciousness as such—the "sciences" of Logic, Psychology, Ethics and Metaphysics. These are commonly termed philosophical. Up to very recent times, these branches of learning have been but little affected by the scientific spirit. Their representatives have been, for the most part, men learned in the wisdom of the ancients, but ignorant of that of the moderns, and but little versed in the methods which have been

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

PLATE XVIII.



Taylor on Crotalidae.

found necessary to the successful prosecution of research. Many confine themselves to working over and over again all that the thinkers of the past have said, and are ambitious of nothing more. Others, having trained themselves with care in the methods which, after more than two thousand years' trial, have been found wanting, laboriously evolve volume after volume, the contents of which is destined to be forgotten before the printer's ink is dry. Their only instrument is introspection; what the observer sees in his own consciousness he ascribes to his fellow, and if his fellow, using a similar method, maintains the contrary, assuredly, thinks he, his fellow is either a liar or a fool.

Psychology was one of the first of the mental sciences to feel the influence of the new spirit. Descartes and Leibniz, Hobbes, Locke, Hume and Hartley and many others, have faithfully endeavored to record the facts of mental life as they saw them, and to give a satisfactory explanation of them. Nor has their work proved fruitless, although its results are far from satisfactory. In the first place, all used introspection as their chief, or only, method. In the second place, the hypostatizing method of the old Greek psychology still persisted. Instead of recognizing that mental facts, like all facts, must be supposed to conform to laws the discovery of which is the chief end of science, we find a tendency to refer the facts observed to half personified "faculties." In the third place, the kindred science of physiology was, and indeed still is, in an imperfect condition, and it was not possible for the psychologist to bring his results into harmony with it. Until this is done, it is safe to say, the foundations of the science of psychology have not been firmly laid.

Within the last twenty years, psychology has entered upon a new era. Fechner, Weber and Wundt, and a host of followers, have undertaken a thorough examination into the simplest phenomena of mental life, especially into the relation of stimulus to sensation. This school uses, wherever possible, the method of direct experiment, and its ideal is to make psychology a science of determinate quantities. These are the psychophysicists in the narrower sense, and the psychophysical laboratory, with its elaborate apparatus for the regulation of stimulus-intensities and measurement of time-intervals, has come, within the last ten years, to be regarded as a necessary part of every great University. Yet it is openly claimed that the net result to the science of psychology of all this outlay is very small; that the analogy between physical and mental facts and laws has been pressed too far; that the results obtained are, for the most part, of physiological significance only; and, in some quarters the cry is heard, "Back to introspection." But we

must remember that psychophysics is itself in the experimental stage, and, until methods of experiment in these new fields have been devised and perfected, we cannot expect definite results.

There has recently been developed, also within the limits of psychology proper, another discipline known as physiological psychology. It endeavors to determine the physiological conditions of consciousness, and, more particularly, the relation of the different qualities of consciousness to the several cortical areas. Much light has been thrown upon these problems, and, as one chief result, it is possible to introduce into introspection a precision before unknown. The English associationists have taught us, for example, on the basis of purely introspective evidence, that our ideas of physical things are complexes, containing visual, auditory, tactual and other elements—that what we call "knowledge" is a mass of dim, subconscious associations. Researches into the physiology of the brain have shown that color, sound and motion certainly, and probably touch, are related to different cortical areas—that lesions of portions of the cortex will destroy knowledge without impairing sensation. This at once supports the conclusions of introspection and enables us to form more accurate conceptions of the complex processes involved.

In England, the home *par excellence* of introspective psychology, Mr. Francis Galton, in his epoch-making book, "Inquiries into Human Faculty," has called attention to the mental idiosyncrasies of individuals. More recent workers in the same line have shown conclusively that introspection cannot give results that will be, in all cases, true. It is impossible to overestimate the importance of this discovery, and there is nothing more surprising than that a fact at once so important and so easily ascertained, should have escaped notice for more than two thousand years. Since the early days of Greek philosophy, for example, the Nominalists and the Conceptualists have waged unending warfare; the Conceptualists maintain that the name of a class awakens an idea or mental state that is not representative of any member of that class; the Nominalists, on the contrary, hold that the class name either awakens a concrete image of a particular member of the class, or else it awakens no mental state whatever—it is a mere *flatus vocis*. And now we know that both are right. Each was describing what introspection revealed to him, and abusing his fellow-student for doing likewise.

Mr. Galton's discovery of the idiosyncrasies of the individual has not only showed the limitations within which alone introspection can be used, but has served to call attention to other forms of comparative

psychology. Researches into the mental life of children, of the lower animals, of the congenitally blind and deaf, of criminals and the insane, have been eagerly prosecuted. It is not easy to estimate the value of this work to psychology proper. It is difficult to get accurate information as to the mental life of even an intelligent and educated man. When I question him, I can have no security that my question is understood, nor can I know that he attaches to the words of his reply exactly the meaning that I do. In inquiring into forms of consciousness still more widely removed from my own, I encounter greater difficulties. Not only does the danger of misunderstanding language increase, but, in most cases, it is impossible to use language at all, and we are compelled to rely upon analogies based upon movements and expression for our knowledge as to what passes in these lower forms of consciousness. It is not, I think, likely that the science of psychology proper will be much the gainer by this work, except in the case of some special problems. But, on the other hand, it is likely that as our knowledge of human psychology increases, we shall find ourselves more and more able to interpret these divergent forms of consciousness.

There is yet another line of psychological inquiry that has been opened within the last twenty years. This is the study of hypnosis and allied "automatic" states. It has been prosecuted, for the most part, in France, and, as the work has been done rather by physicians than by psychologists, the value of the inquiry to the pure science is, as yet, undetermined. Several attempts have been made, however, to bring these facts to bear upon the general theory of psychology. The most comprehensive and, in my opinion, the most important, is that made by Pierre Janet in his work on "Mental Automatism" ("L'Automatisme Psychologique") published in Paris about five years ago.

Yet another "*Richtung*" is that commonly known as "Psychical Research." Its object is the investigation of phenomena supposed to be "supernatural" or "supernormal." Although not necessarily psychological, it so happens that the great majority of such phenomena have been found to be explicable by simple psychological laws, and it seems, therefore, proper to include it in an enumeration of the chief forms of contemporary psychology. Moreover, many of the phenomena which have not, as yet, been explained by known laws, such as those of telepathy and clairvoyance, would seem to require the assumption of new distinctively psychological principles.

The conception of evolution in psychology, as in all other branches of science, exerts a controlling influence. It is clearly recognized that man's mind, like his body, is what it is by virtue of the environment in

which it exists. The law of preservation has determined the development of the special senses, the emotions, the impulses, and even of the aspects of consciousness which we are accustomed to regard as distinctively human—discursive thought, reasoning and volition. In some cases it is possible to classify mental phenomena teleologically where other bases of classification prove inapplicable, and phenomena formerly unintelligible sometimes become intelligible from this point of view. Yet it must be admitted that genetic psychology is yet to be. The history of some forms of consciousness, it is true, has been fairly well ascertained. We may be said, I think, to know something of the origin of the emotions, of the "recept" and concept, of many impulses and, perhaps, of the simpler types of volition. But no systematic and comprehensive genetic theory has yet been propounded that has met with any considerable acceptance.

It is too late, then, for those who are addicted to philosophy, as distinguished from science, to lament the introduction of scientific methods into psychology. Little by little those methods of exact and painstaking research will make their way into every department of human thought. We are apt to talk much of Logic, Psychology, Ethics and Metaphysics as being the mental "sciences." We forget that, as sciences, they do not yet exist. They exist only as rather ill-coordinated tendencies. Each has a subject matter which is sufficiently well-defined for practical purposes, and each has a few well-worn generalizations that meet with some acceptance. But the very facts with which they deal are still, in large measure, subjects of dispute; the conceptions under which it is proposed to systematize those facts are rough hewn from the vulgar common sense of the community; ill-defined and crude, much labor must be expended upon them before we can hope to make our facts intelligible. This is the work to which the student of mental phenomena must address himself. If we draw a distinction between science and philosophy, even though we cannot, as yet, claim for psychology the proud name of a science, let it be once for all understood that she is to be regarded as a scientific rather than a philosophical discipline.

But why should any such distinction be drawn? The word "philosophy" is, as I have said, frequently applied to those branches of learning which we have inherited from the ancients, which still preserve, on the whole, their ancient form. And the usage is not without justification. For the "philosopher" was originally a man who pursued knowledge for its own sake, and the knowledge which he acquired constituted his philosophy. But this is what we mean to-day by "sci-

ence." Mathematics, physics, astronomy and psychology were all alike parts of the Greek "philosophy," and it is not surprising that we have retained the old name for the older science while we have coined a new word for the newer. In course of time, however, all branches of human knowledge will certainly be brought within the domain of science, and the older word will be free for a new sense. Now there remains a science, as yet undeveloped, for whose designation this term should be reserved. When the other sciences have been brought to higher perfection, and we have obtained a more exact conception of the cosmos, we shall desire to understand that cosmos in its relations to the human being as such. This science, to which all other sciences will contribute, which will formulate the laws under which the human consciousness stands in its relation to the totality of existence and deduce therefrom the principles by which the life of the individual is to be guided, may justly be termed by that ancient and revered name, Philosophy,—The Science.—W. ROMAINE NEWBOLD.

ARCHEOLOGY AND ETHNOLOGY.[1]

The Contention of Mr. J. D. McGuire that stone polishing must be and is as old as stone chipping, and that we have no evidence of a time when man did not know how to polish stone and make pottery, induced me when in Europe last summer (1894) to ask several explorers of caves and drift beds in Italy, England and Germany, whether, like Mr. McGuire, they had come to suspect the presence of pottery or polished stone in these oldest human culture layers.

Professor Dr. Johannes Ranke, of Munich, has been kind enough to send me the following very interesting series of notes upon the subject, and I hereby print them subjoined to my questions (in italics) as originally propounded to him.—H. C. MERCER.

The Results of Cave Exploration in Germany.—I. *Have you found proof in German (Austria-Hungary, etc.) caves, of a time when man was in a Paleolithic state—chipped but could not polish stone—and make pottery?*

Ans. My observations and investigations of prehistoric man are given in full in my book "Der Mensch," Vol. II, (II edition, 1894, Leipzig, Sibleoz Institute), where answers to all your questions may be found.

Further, I would say, that the objects found in one layer of a cave are only in very rare cases proved to be contemporaneous, for example, the case of the celebrated excavations of Dr. Nüesch, Schaffhausen, Switzerland, in "Schweizerbild," (1. Der Mensch, II, p. 454); in other caves many objects of different epochs, some even modern, are found in the same layer. It is on these grounds that I can give no complete proof regarding the *cave finds* in the district referred to by you, Austria-Hungary, Germany, Switzerland.

On the contrary, we have in Germany, Austria-Hungary, places of discovery, not properly caves, in undisturbed diluvial layers, in which objects found in one layer are entirely proved to be of contemporary date. The place of discovery near Schaffhausen is not a veritable cave, but a shelter under over-hanging rocks, where a layer has been found, layer No. 4, with many remains of the reindeer period, cave bear, diluvial horse, etc. No polished, but only chipped stone; no pottery, no dog. The place of discovery by Saubach offered undisturbed

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

diluvial layers with bones of mammoths, rhinoceros, cave lion, and cave tiger, only chipped; no polished stone implements, no pottery, no dog.

The best examined diluvial places of discovery (reindeer period) in Germany, on the Schasteu Quelle, gives only chipped, no polished stone implements, no pottery, no dog.

In the celebrated caves, Ofnet, Hohlefels, Raubershohle, in the layer of discovery of the diluvial man, chipped stone implements were found with pottery, but the pottery is much later and belongs mostly to the Hallstate period. From the Kesslerloch I have myself found a fragment of pottery, but it is much more recent. Where fragments of pottery have been found in Germany together with remains of diluvial man, the fragments of pottery are, in my opinion, decidedly much later. All clean places of discovery in undisturbed diluvial layers yield no pottery. Fragments of pottery are wanting also in the station lately so much talked of, containing mammoth, etc., in Piedmont (v. my book, II, p. 493).

II. *Has pottery been found in layers with mammoth, rhinoceros and cave bear, etc., in German caves?*

As above mentioned mammoth, rhinoceros, cave bear, have been found with pottery in the same layer, but not contemporaneously, the potsherds are undoubtedly of much more recent date. The layers in question were not undisturbed; in the undisturbed layers at Schaffhausen, no fragments of pottery are found.

III. *Has polished stone been found in similar layers?*

Where polished stone implements have been found in the same layer with diluvial remains, the layer has not been undisturbed. Fragments of pottery and other things were found of the Neolithic period or a still later period. In undisturbed diluvial layers, in our investigated districts, neither polished stone implements nor fragments of pottery have been found.

IV. *Is there any evidence in German caves or gravel beds to prove or disprove subdivisions of the oldest stone period (Paleolithic) into river drift, Mousterien, Solutrien and Magdalenien (of Mortillet)?*

For this kind of discovery we are without the necessary ground. The richest discoveries made up to this time, at least in Germany, have been of the Reindeer period.

V. *From excavation of German caves do you think that where very prominent and conspicuous, they contain in layers one above another, traces of all savage people who have inhabited the region, i. e., that they*

were places of temporary resort used at all times in man's history, or that they were only at one age, the fixed habitations of a race of Cave Men?

Our caves in Germany point out in their contents a now almost uninterrupted chain of discoveries from the diluvial period, through all the centuries to modern times. Besides bones of diluvial animals, I have found in the same layer pieces of or example of a cooking-pot, also fragments of the Hallstate period. An exact division of layers is almost impossible to accomplish. An exception is offered in the above referred to station of Dr. Nüesch in Schaffhausen (v. my book) where the different layers are distinctly divided. There one finds layers of the different periods one above the other, of all peoples who lived in that region. The caves are like towns, periodical refuges, which were used in all ages of man, and still are to-day.

In the cave region of the Franconian Jura, in Bavaria, in the so-called Franconian Switzerland, where you have already excavated yourself, a people in the Neolithic period have been proved to have lived in many grottoes and caves. Our Neolithic people were also cave dwellers there, as well as the diluvial man who lived there, whose traces, mixed with more recent, have been proved to lie there. "Cave Men" were also there before our Neoliths (v. my book, p. 545).

VI. *Have you noticed any lines of direction of migration in the cave evidence for all Europe? Do the layers get thicker and the remains older as you advance geographically in any given direction, so as to indicate that man of that time came to or from any direction?*

I have been unable to find any traces of the wandering of diluvial man (v. in my book in map of diluvial discoveries on page 418).

JOHANNES RANKE.